1985

A Systems Development Life Cycle study of the Information Center.

Lechleitner, Matthew L.

Monterey, California: U.S. Naval Postgraduate School

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

A SYSTEMS DEVELOPMENT LIFE CYCLE STUDY
OF THE INFORMATION CENTER

by

Matthew L. Lechleitner

March 1985

Thesis Advisor: Barry Frew

Approved for public release; distribution is unlimited

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A Systems Development Life Cycle Study of the Information Center		5. TYPE OF REPORT & PERIOD COVERED Master's Thesis March 1985
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Matthew L. Lechleitner		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Postgraduate School Monterey, CA 93943		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Postgraduate School Monterey, CA 93943		12. REPORT DATE March 1985
		13. NUMBER OF PAGES 132
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution is unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

information center, end user computing, microcomputers, systems development life cycle, end users, personal computing, personal computers

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

End user computing has penetrated most large organizations in an uncontrolled fashion. The newness of the technology, the lack of management expertise, and the inability to gain corporatewide control under the traditional organizational structure have often resulted in inefficiency, incompatability, and missed opportunities. One solution to this situation is the Information Center (IC). ICs are centralized coordination centers for end user computing and offer end user (Continued)

ABSTRACT (Continued)

computing expertise. ICs may be any combination of consulting services, training services, mainframe computer terminals, or microcomputers. This thesis examines the IC concept from the viewpoint of the manager tasked with implementation and provides a methodology, the Systems Development Life Cycle, to evaluate and implement an IC. Each phase of the methodology is explained and some innovative ideas on IC implementation and operation are provided. Examples of past successes and mistakes are also prèsented.

Approved for public release; distribution is unlimited.

A Systems Development Life Cycle Study
of the Information Center

by

Matthew L. Lechleitner
Lieutenant Commander, Supply Corps, United States Navy
B.S., United States Naval Academy, 1973

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION SYSTEMS

from the

NAVAL POSTGRADUATE SCHOOL
March 1985

ABSTRACT

End user computing has penetrated most large organizations in an uncontrolled fashion. The newness of the technology, the lack of management expertise, and the inability to gain corporatewide control under the traditional organizational structure have often resulted in inefficiency, incompatibility, and missed opportunities. One solution to this situation is the Information Center (IC). ICs are centralized coordination centers for end user computing and offer end user computing expertise. ICs may be any combination of consulting services, training services, mainframe computer terminals, or microcomputers. This thesis examines the IC concept from the viewpoint of the manager tasked with implementation and provides a methodology, the Systems Development Life Cycle, to evaluate and implement an IC. Each phase of the methodology is explained and some innovative ideas on IC implementation and operation are provided. Examples of past successes and mistakes are also presented.

TABLE OF CONTENTS

LIST OF FIGURES

I. INTRODUCTION

A. INFORMATION CENTER DEFINED

The concept of the Information Center (IC) was formalized by International Business Machines (IBM) Canada in 1974 [Ref. 1: p. 73]. IBM defines the IC as "a portion of the Information Systems development resource organized and dedicated to support the users of Information Systems services in activities such as report generation and modification, data manipulation and analysis, spontaneous inquiries, etc." [Ref. 2: p. 131] Other corporations have used, changed, renamed, refined, and redefined the IC concept to fit their own purposes. Although this flexibility may appear to be counterproductive, it seems to be one reason for the popularity of ICs.

Many corporations have adopted the name Information Center. Some of the other documented names for ICs include Information Resource Center [Ref. 3: p. 27], Client Support Center [Ref. 4: p. 137], User Support Group [Ref. 5: p. 16], Resource Center [Ref. 6: p. 19], User Development Application Center [Ref. 7: p. 65], Solution Center [Ref. 8: p. 30], and Office Technology Center [Ref. 9: p. 71].

The term Information Center has also been used to designate other manual or automated services such as library services, abstract and document retrieval services, and

central repositories for documents. Although valid, these services represent an entirely different concept and are not a consideration of this research.

The IBM definition of the IC focuses on the use of a mainframe computer. This narrow focus does not adequately define the IC concept used by many corporations. Therefore, the following three definitions are provided:

> The Information Center is not a place; it is a concept which combines technology and the technical expertise of the MIS department of the organization with the business skills of those in other areas in the organization to better leverage both the power of information processing technology and the organization's data. [Ref. 10: p. 42]

> ...an IC is an organization whose objective is to provide the tools and support that allow end users to deal directly with some subset of their MIS needs. As such, the IC facilitates end-user computing, providing tools rather than solutions. [Ref. 11: p. 16]

> An information center consists of a facility and resources which can allow users to carry out their own data processing according to their immediate needs. [Ref. 12: p. 63]

B. PURPOSE

The purpose of this research is to develop a method or guide for managers to evaluate and implement the IC concept. Therefore, the perspective of this thesis is from that of the manager tasked with the responsibility for evaluation and implementation of the IC. This person is often from the data processing or management information systems department. The methodology used is the systems development life cycle (SDLC). Selection of this method was based on the idea that an IC can be thought of as a large project or

system. Managers need a framework within which they can develop the IC concept and SDLC provides one of the simplest, most complete, and adaptable methods available. Recently, SDLC has gained great popularity within the information industry in the design of computer information systems. Another reason to use SDLC is that managers who used SDLC before will be able to more easily evaluate and implement ICs.

C. DESCRIPTION

Descriptions of ICs are varied and plentiful. One attempt to provide a standard description of ICs is the following:

> The centers (ICs) may differ in the services and facilities they offer...But information centers all have the fast, convenient characteristics of the hot line, and they all endeavor to empower users. [Ref. 13: p. 98]

ICs are more commonly found in large corporations, but are rapidly migrating to smaller ones as the popularity of the IC concept increases. Most IC implementations include a physical facility with a manager, an administrative assistant or secretary, and one or more people designated to conduct training and consultation. Although other positions and functions can be found in the various ICs, this description is fairly generic. The physical layout usually includes some sort of terminal or mix of terminals. The quantity and arrangement of terminals will depend on the purpose of the facility. In physical terms, the IC may be

used as a site for training, for daily user access, for user or corporate hardware and software evaluation, or for hardware and software selection. ICs frequently include a combination of more than one of these purposes.

ICs can be partitioned and labeled in several different ways. For purposes of description they are easily classified as follows:

1. Host-Connected
2. Stand-Alone
3. Networked
4. Mixed

A Host-Connected classification means that the IC is composed of terminals (some of which may be microcomputers used as terminals) connected to the host computer, usually a mainframe computer. All work is done through the use of the host computer. A good example of this type is installed at Anheuser-Busch where "It is virtually impossible for employees to buy a microcomputer." [Ref. 14: p. 13]

A Stand-Alone classification involves the use of one machine by one individual to process information. This is usually a microcomputer. This type of IC frequently involves provision of some type of purchase service, maintenance service, introductory training, coordination for compatibility, setup (including software installation), instruction on equipment care and use, and the opportunity

to sample and evaluate different machines (usually with strong orientation toward microcomputers and software).

A Network classification may involve outside timesharing services. Coordination and proper use of these services are emphasized. Another type of Network classification involves local area networks (LANs) that are not connected to host computers but are established to fulfill a need to maximize local communications.

The most common classification is the Mixed classification. It is also the most advanced implementation of the IC. It is a combination of any two or all three of the other classifications. The range of sophistication in the mixed classification is broad. At the low end, the micro-mainframe connection involves the transfer of data files which can be used by the software and operating systems of either the microcomputer or the mainframe. At the high end, all three of the other classifications can be implemented in an integrated fashion.

Some implementations will be difficult to categorize in this manner. For example, implementations which are purely conceptual, trivially simple, or based on distributed applications may be hard to assign to any of these categories. Nevertheless, these implementations will favor one of the four classifications listed above and can be categorized with one of these four.

It is important to acknowledge the present state-of-the-art in information technology in order to have some idea of where the IC concept is heading. F. Warren McFarlan and James L. McKenney, Harvard University, have written about the concept of phased merging of different technologies. Their position is as follows:

> Organizationally, there are multiple paths which can be followed in effecting the merger of the three islands (Data Processing, Telecommunications, and Office Automation) of technologies as a firm moves toward a merged information services function. [Ref. 15: p. 34]

The multiple paths they make reference to are the following:

1. Merging Data Processing and Telecommunications
2. Merging Telecommunications and Office Automation
3. Merging Data Processing and Office Automation

In this context the three singular IC classifications of Host-Connected, Stand-Alone, and Networks can be compared with Data Processing, Office Automation, and Telecommunications, respectively. The state-of-the-art for implementing these paths exists today. On the other hand, complete integration of the three paths does not exist. Although the information processing industry has been working toward this goal, only limited integration has been achieved.

Although McFarlan and McKenney are not addressing ICs in particular but rather information technology as a whole, their logic can be extended to IC organization and technology. They summarize their thoughts with the following:

...at present a wide array of organization patterns are possible as an organization advances toward the totality of information services. We see this heterogeneity as transitional, with the eventual merger of these islands into a central hub occurring in most organizations; certainly for policy making, planning, and control purposes, and in many settings, for line control and execution. The timing of these moves in any organization is situation dependent, involving current corporation structure and leadership style, speed at which the firm has been staying modern in these technologies, individual retirement plans, current development priorities, and so forth. [Ref. 16: p. 36]

II. SYSTEMS DEVELOPMENT LIFE CYCLE METHODOLOGY

A. BACKGROUND

The SDLC, applied to an IC, is a combination of the systems approach and the life cycle approach. The systems approach causes one to view the IC as a system which contains its own subsystems and at the same time is part of a larger system. The life cycle approach considers the fact that the IC is created, is developed, grows, matures, and either expands into something else or becomes obsolete. Although one can not always predict the future, especially concerning a concept as new as the IC, there are certain aspects that can be predicted which can contribute to a better IC.

This thesis views the systems approach much the same way as Kenneth Boulding did in 1956, as summarized by James Wetherbe in 1984:

> The systems approach is the way of thinking about the job of managing. It provides a framework for visualizing internal and external environmental factors as an integrated whole. It allows recognition of the function of subsystems, as well as the complex suprasystems within which organizations must operate. Systems concepts foster a way of thinking which, on the one hand, helps the manager to recognize the nature of complex problems and thereby to operate within the perceived environment. It is important to recognize the integrated nature of specific systems, including the fact that each system has both inputs and outputs and can be viewed as a self-contained unit. But it is also important to recognize that business systems are a part of larger systems--possibly industrywide, or including several, maybe many, companies and/or

industries, or even society as a whole. Further, business systems are in a constant state of change--they are created, operated, revised, and often eliminated. [Ref. 17: pp. 32-33]

The value and flavor of the systems approach are described by the following:

> The systems approach is a perspective--a way of identifying and viewing complex, interrelated functions as integral elements of systems. Although there is concern for the individual parts of a system, emphasis is on the integration of the components to produce the end products of the systems themselves....Systems analysis provides a set of strategies and techniques for dealing with complex problems, based on hierarchical partitioning methods applied through various levels of abstraction to analyze problems and synthesize solutions....A basic principle of systems project management is that the systems development life cycle should be a guide, not a cookbook....systems analysis is a process that involves repeating, or iterating, a series of process steps to build an understanding of current systems and procedures and to define new systems. [Ref. 18: pp. 14, 22, 72, 167]

B. EXAMPLE

The best way to explain, in this thesis, how the SDLC is applied to ICs is to provide a facetious but pedagogic example. Consider the example of a person standing outside in the cold in a strong breeze. He starts out by saying he has a problem: he is cold. This is what an untrained person says. But a trained person, similar to a systems analyst, would say that being cold is the symptom and that the real problem is that he needs shelter. Therefore, the problem is now well defined.

The next step is to determine the requirements. The untrained person says he needs to buy a house. The analyst

instead reviews the shelter requirements. For example, a house may not be needed in the tropics or there may be other options like a trailer home or renting. The analyst determines that a dwelling is needed and because there are other system requirements (e.g., standard of living, social status, family size, weather, cost, etc.) the analyst starts describing a system that generally fits the requirements. The next step is to determine details, such as number of toilets and amount of insulation required. At this point the analyst realizes that this person's car must also be protected and that it should be part of the shelter system. The analyst goes as far back as necessary to re-analyze the system. The analyst determines that a garage or carport would do nicely. When integrated with the original requirement the analyst realizes that the garage or carport must be attached to the house in order to provide shelter for the person when walking from the car to the house. After reviewing requirements and creating several designs or options, the analyst considers all factors such as cost, amount of shelter and other uses and chooses the proper house and car storage system.

Since this is a life cycle study, things such as long-term maintenance, property appreciation, and expected life were evaluated based on the overall objectives of the person needing the shelter. The choice is made based on the

foregoing and the house is built and cared for in the manner previously planned.

Although this example is simplistic, it does explain the procedure and general thought process that makes the SDLC a valuable methodology and useful in the development of an IC. Iteration, going back to the beginning or as far as necessary, and hierarchical decomposition, "the breaking down, or partitioning, of a large problem, or project, into a series of structured, related, manageable parts" [Ref. 19: p. 52] were demonstrated in the example. At each major decision point in the example, the feasibility of continuing the design as it had been developed up to that point had to be determined.

C. PHASES AND ACTIVITIES

Figures 1 and 2 are partially modified versions taken from a book by Michael J. Powers, David R. Adams, and Harlan D. Mills [Ref. 20: pp. 42, 50]. Figure 1 presents the phases and activities of the SDLC utilized in this study. "A phase is a set of activities that brings a project to a critical milestone....An activity is a group of logically related tasks that, when completed, lead to accomplishment of a specific objective." [Ref. 21: pp. 50-51] Figure 2 indicates checkpoints where a conscious decision whether to proceed, delay, speed up, postpone, or abandon should be made.

INVESTIGATION PHASE

1. Initial Investigation
2. Feasibility Study
3. Recommendation

ANALYSIS AND GENERAL DESIGN PHASE

4. Existing System Review
5. New System Requirements
6. New System Design
7. Detailed Design and Testing Planning

DETAILED DESIGN AND TESTING PHASE

8. Technical Design
9. Performance Specification and Measurement Planning
10. Staffing
11. Prototyping and System Testing
12. General Implementation Planning

INSTALLATION AND IMPLEMENTATION PHASE

13. Marketing
14. Training
15. Staffing and Consulting
16. Hardware
17. Software
18. Managing and Controlling
19. Opportunities

REVIEW PHASE

20. Development Recapitulation
21. Post Implementation Review

Figure 1. SDLC Phases and Activities

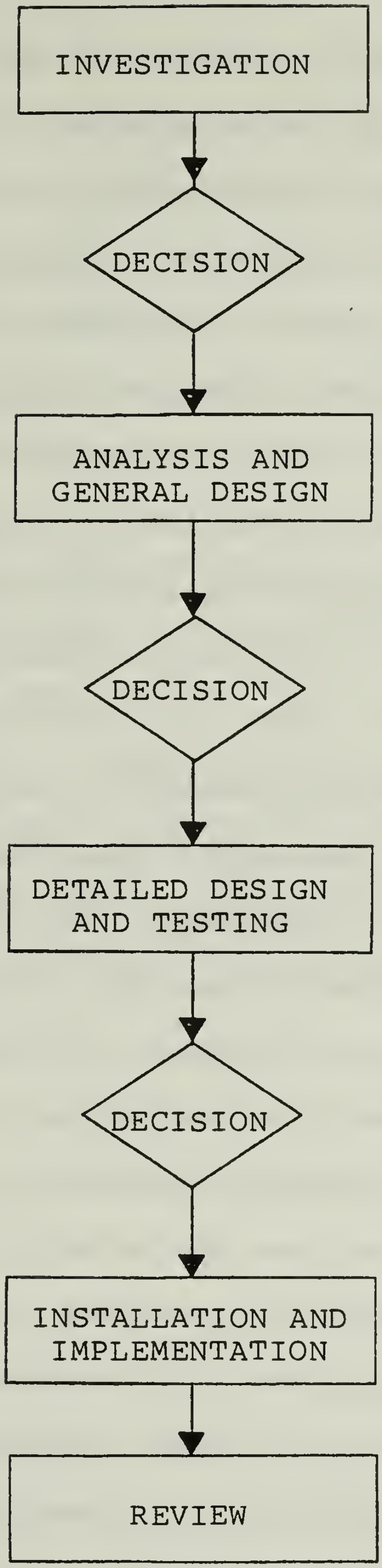


Figure 2. Major Decision Points

Each chapter following this chapter, with the exception of the conclusion chapter, deals with one of the phases of the SDLC. Since these chapters contain explanations of the purpose and objectives of each phase, only a broad overview will be provided in this chapter. Five phases have been used in this study. Figure 1 provides a breakdown of the activities of each phase. These activities have in some cases been modified to reflect considerations peculiar to an IC. The purpose of the investigation phase is to define the problem, identify requirements, and determine general feasibility of one or more solutions. The purpose of the analysis and general design phase is to develop a more detailed analysis, create a general design for an IC, and reconfirm feasibility based on the additional information acquired. The purpose of the detailed design and testing phase is to reduce the general design to a detailed design, to test the system (usually with a prototype), to examine feasibility one last time, and make any last minute changes. The purpose of the installation and implementation phase is to convert from the old system to the new IC system as painlessly and professionally as possible. The purpose of the last phase, the review phase, is to immediately evaluate the methodology and at a later time to review and evaluate the operation and success of the IC in meeting its objectives.

D. CONTROL

Figure 2 shows the major decision points as diamonds and the phases as boxes. These decision points indicate feasibility reviews and are only made after each of the first three phases. The decision to proceed should be made by a top level manager or a high level steering committee. On the other hand, the SDLC study should be conducted, if at all possible, by a team of people:

> If the project proposal is approved, management generally organizes a project team and assigns responsibility for the project to it. The specific personnel or type of personnel to be included on the project team should be defined under the resource requirements section of the project proposal. [Ref. 22: p. 123]
>
> The organization of a project team is a prerequisite to good systems analysis. Different types of expertise are required to thoroughly consider all system variables. For example, the systems analyst provides primarily computer technology-oriented skills. Without adequate representation from the various departments affected by the information system, various dimensions of their needs and requirements are apt to be overlooked. [Ref. 23: p. 123]

Figure 3 is a partially modified version of a figure developed by James C. Wetherbe [Ref. 24: p. 11]. The main concept of Figure 3 is that of iteration and hierarchical decomposition. As the SDLC study starts at the top of Figure 3 it progresses to the bottom, through each phase, until some new development causes a return to an earlier phase or to the beginning. This is shown by the direction of the arrows. This concept is explained by Wetherbe:

> The steps in the cycle (SDLC) are neither discrete nor one-time processes. Rather, the systems development cycle is iterative and evolutionary. The steps in the cycle,

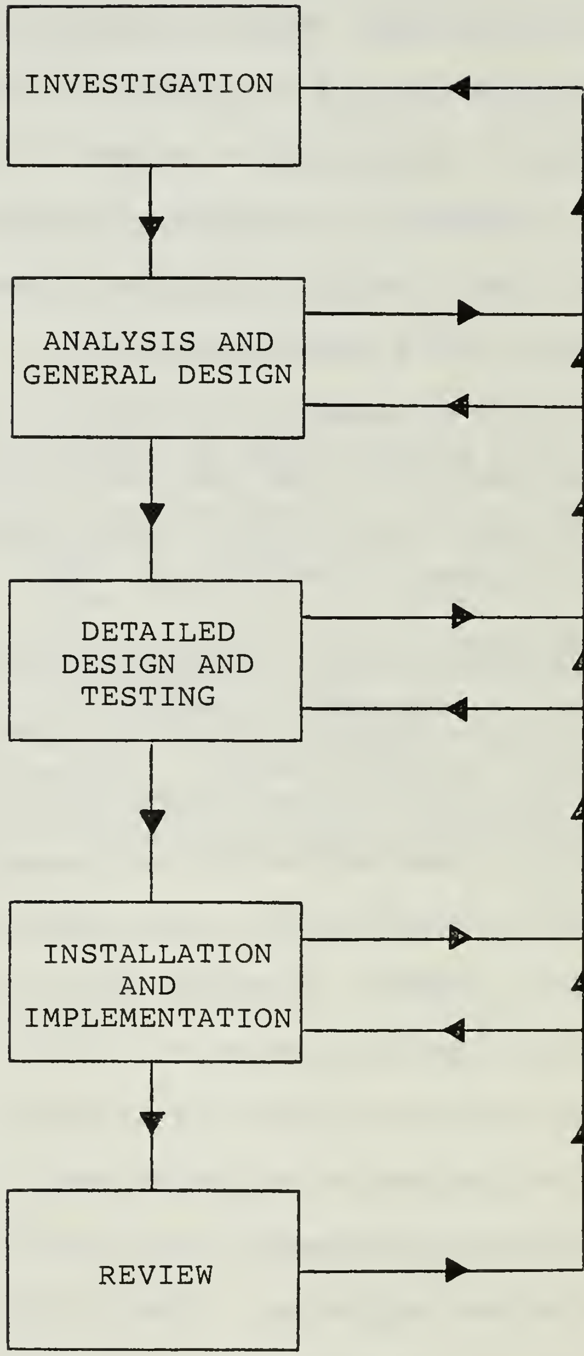


Figure 3. Iteration and Hierarchical Decomposition Process

however, retain a basic sequential flow from the point of origin of the development cycle--"new problems and/or opportunities arise." At any step in the cycle, previously unidentified problems and/or opportunities may be discovered. In such cases, it is important to insure proper integration of a solution to a new problem and/or a new opportunity. Making even a minor change to a system without proper consideration of what has been established previously, can cause unanticipated and undesirable rippling effects. [Ref. 25: p. 11]

E. GENERAL COMMENTS

Some final words on the SDLC contain both advice and caution:

> The systems approach is a problem oriented one. It is a highly creative process, and the outcome is dependent upon the people involved as well as on the resources available....Moreover, in any given situation, the available data and theoretical framework are likely to be incomplete and somewhat ambiguous so that certainty is out of the question. Imagination, judgement and courage are needed. The set of possible future environments in which proposed solutions must remain valid have to be imagined, and their potential effects evaluated. Alternative solutions must be generated, characterized and evaluated. Even the way the problem domain under study is subdivided for conceptual manageability is a matter of considerable importance that demands responsible judgement and originality. The traditional subdivisions along jurisdictional or organizational lines, or in terms of standard academic disciplines, are not necessarily the best and are certainly not the only options. Each aspect has its place and must be considered. Clearly, creativity is called for at many points in the process of achieving a problem solution. [Ref. 26: p. 9]

> A vast, complex system has many elements with significant interactions that are often not understood. Isolating the elements for analysis may lead the systems analyst to overlook the interactions that occur when the elements are combined into a system....In particular, a system that involves human behavior (e.g., an organization) involves varying and changing variables that interact with, and/or compromise, the system. One of the key realizations contributed by the systems approach is that the interactions among elements in a system can be as, or more, important than the elements themselves. A system is more than just

the sum of its parts and must be considered as such. [Ref. 27: pp. 33-34]

Although the process of systems analysis is straightforward in concept, it can be exceedingly complex and difficult in application. It must be emphasized that systems analysis is not a panacea. It is not a black box into which one drops problems at one end and automatically receives solutions at the other. It is, as was pointed out, a framework in which a multi-disciplinary group of scientists, engineers and technicians can achieve a unified problem-oriented focus, and this common research orientation maximizes the possibilities for achieving successful solutions of complex problems. The real value of systems analysis lies in the fact that it forces a manager to structure his thinking to the problem at hand, to prepare a solution given a particular set of circumstances, to prepare alternatives and to establish requirements. [Ref. 28: p. 12]

III. INVESTIGATION PHASE

A. PURPOSE OF INVESTIGATION PHASE

> The chief purpose of the investigation phase is to determine whether a problem or need requires a full systems development effort or whether another course of action is appropriate. One alternative course of action may be to do nothing, to leave operations as they are. Another alternative may be to undertake a project to upgrade, or maintain, the existing system rather than to develop a new one. [Ref. 29: p. 44]

During this phase, the problem is defined, needs are identified, and possible solutions are presented. This phase has two parts. The first part is the initial investigation. The second part is the feasibility study. Determination of the need to conduct a feasibility study is the result of the first part. At the conclusion of the investigation phase which is also the conclusion of the second part, a decision must be made whether or not to proceed with the next phase of the SDLC.

B. INITIAL INVESTIGATION

1. Source Identification

The source of the request or order to implement an IC or to initiate an SDLC, may come from any department or individual within the corporation or organization. It is important to identify this party early, preferably at this point in the SDLC. Knowing this party's identity can assist in the determination of the initial support groups and

possible behavioral problems. If this party is top management, then one can expect high level support and can plan accordingly. If not, then a different outlook will be required. If this party is a group, then it is valuable to know who the proponents are or at least the ratio of proponents to opponents. If an IC is established under the misconception that the entire group supports the idea when, in fact, they do not, the consequences may be disastrous. Identification of this group or individual will also help to identify some of the political issues that may have an impact on the IC decision. Early identification of the behavioral aspects and of the source of the IC request will more than likely have a profound impact on the determination of the approach to be taken and the problem to be solved. Current literature stresses the sensitivity of ICs to various factions of resistance, political infighting, and the necessity of top-management support.

2. Motivation

It is important to understand this party's motivation. There will usually be more than one reason for wanting to implement an IC. Among the various reasons for implementing the IC, two are mentioned more than others. One is to reduce the applications backlog and the other is to control the proliferation of microcomputers. Some additional reasons are to coordinate technological growth, to provide end user training, to provide data security and

integrity, to give users control of their own data, to provide consultation to end users, to administer end user computing, to reduce the effect of system analyst and programmer shortages, to provide a test bed for new hardware and software products, to reduce the load on the host computer, to improve data processing department's relations with user departments, and to provide a central point for end user standards.

In addition to the advertised reasons for implementing an IC, it is vital to uncover hidden motivations, as well. A very common hidden motivation is internal empire building or managerial territorial conflicts. Another hidden motivation is the need or desire to match or even surpass a competitor's position. This may be nothing more than a race to be the first to install the latest technology or, if the competition cannot be equalized, it may cause the corporation to fail. Another hidden motivation is to effect an organizational change. This is often done to accommodate personalities or poor individual performance. Usually, the implementation of the IC has little effect on sustained performance and rarely does it solve personality problems. The impact of not correcting these situations prior to taking any action can be devastating to the success of the IC. Finally, there may be other hidden motivations and these should also be identified and corrective action taken if necessary.

3. The Envisioned Information Center

The interested party may already have their own idea of what will constitute the IC. Although this may be less than optimal, it is important to record and thoroughly understand this party's idea. At this point in the SDLC, there should be no attempt to change their position. It may turn out that their intuition or analysis is accurate and that any conflict now, may encourage future conflict, unnecessarily. Likewise, it is likely that this party will view the IC as a one time implementation when in actuality it should be viewed as an evolutionary process [Ref. 30: pp. 211-212]. Therefore, this party's view will probably change as the SDLC study progresses.

4. Research on the Information Center Concept

It is virtually impossible to address the issue of an IC unless one understands the IC concept. Therefore, it is necessary to learn as much about ICs as possible. At a minimum there should be a literature search. This can be started at the local library or university. This research can be extended to include the hiring of a consultant to give a presentation on the IC concept. Attending workshops or seminars can also be rewarding, as well as discussions with others who have already implemented an IC. Visits to IC sites should be arranged if possible. Vendors can provide a different view. It may also be feasible to join a local users group. IC users groups and special interest

groups have been gaining popularity and it is not difficult to find one in almost any section of the United States [Refs. 31: p. 26, 32: p. 26, 33: p. 12]. It may also be useful to join certain computer related professional associations. Lastly, any opportunity not already mentioned should be considered. Properly conducted research on the nature of ICs and learning from the successes and failures of other groups can save a considerable amount of time and money.

5. <u>Problem Definition</u>

At this point in the study, the problem to be addressed should be formally stated or defined. This can be somewhat difficult because of the foregoing and because it is often difficult to separate symptoms from causes. It will involve determination of general business objectives, information system objectives, and user needs. This is not the place to espouse solutions. It is quite possible that the problem may require something different than an IC.

a. Goals, Strategy, and Competitive Position

Alignment of the problem to business objectives is critical to proper perspective. Corporate goals, strategy, and competitive position will be a strong guide in determining areas that should be exploited. It will also be a large determinant of the economical justification of the solution. For example, if the corporate goal is to capture seventy percent of the market, then alternate goals such as

maximizing profit will be secondary considerations. If top management will not disclose the corporation's goals (possibly due to security concerns) or has not performed any long-term strategic planning, then it is recommended that goals should be established based on the best available information. [Ref. 34: p. 11] Competitive position is determined by the success of the corporation's strategy. McFarlan gives a synopsis of each of Michael E. Porter's three categories of competitive strategies as follows:

> One (strategy) is cost based, when a company can produce at a much lower cost than its competition. Companies selling commodities and high-technology products can use such strategies. A second type is based on product differentiation, when a company offers a different mix of product features such as service and quality. (Companies selling baby care products and cosmetics can use this strategy.) The third type is specialization in only one niche of a market, distinguishing itself by unusual cost or product features. Its strategies may be called focused. (An example would be focusing on a narrow range of industrial grade papers to avoid advertising battles.) [Ref. 35: p. 100]

Porter identifies these three strategies as "generic strategic approaches" [Ref. 36: p. 35] and labels them as follows:

1. overall cost leadership
2. differentiation
3. focus

It is important to understand which strategy is being used by the corporation so that the solution will maximize the corporation's competitive position. Additionally, awareness of the competitive position, such as knowing the market share or profit differentials of the industry, can

assist in development of areas that will create more return on the investment. If the solution supports this position, then it will provide the opportunity to exploit the competition's weaknesses and to capitalize on the corporation's strengths.

b. Information System Strategy

Understanding the corporate strategy and goals is only part of the overall picture. The IC must also fit into the information systems strategy. The data processing workloads, emphasis areas, and future plans should be considered. The IC should complement the data processing, telecommunication, and office automation efforts unless obsolescence, economy reasons, or some other valid reason make this undesirable.

c. Management Structure

Understanding the management structure can help to identify the users. A common method to describe a corporation's management structure is depicted by a pyramid segregating the three levels of management: top management, middle management, and operational management. This idea is carried one step further by Dan Trimmer [Ref. 37: p. 43] where in Figure 4 he shows the trend of data processing support for each level. Figure 4 shows a shift toward more data processing services for top and middle management. This trend points to the growth rate of these classes of users and in general the need to solve their problems and

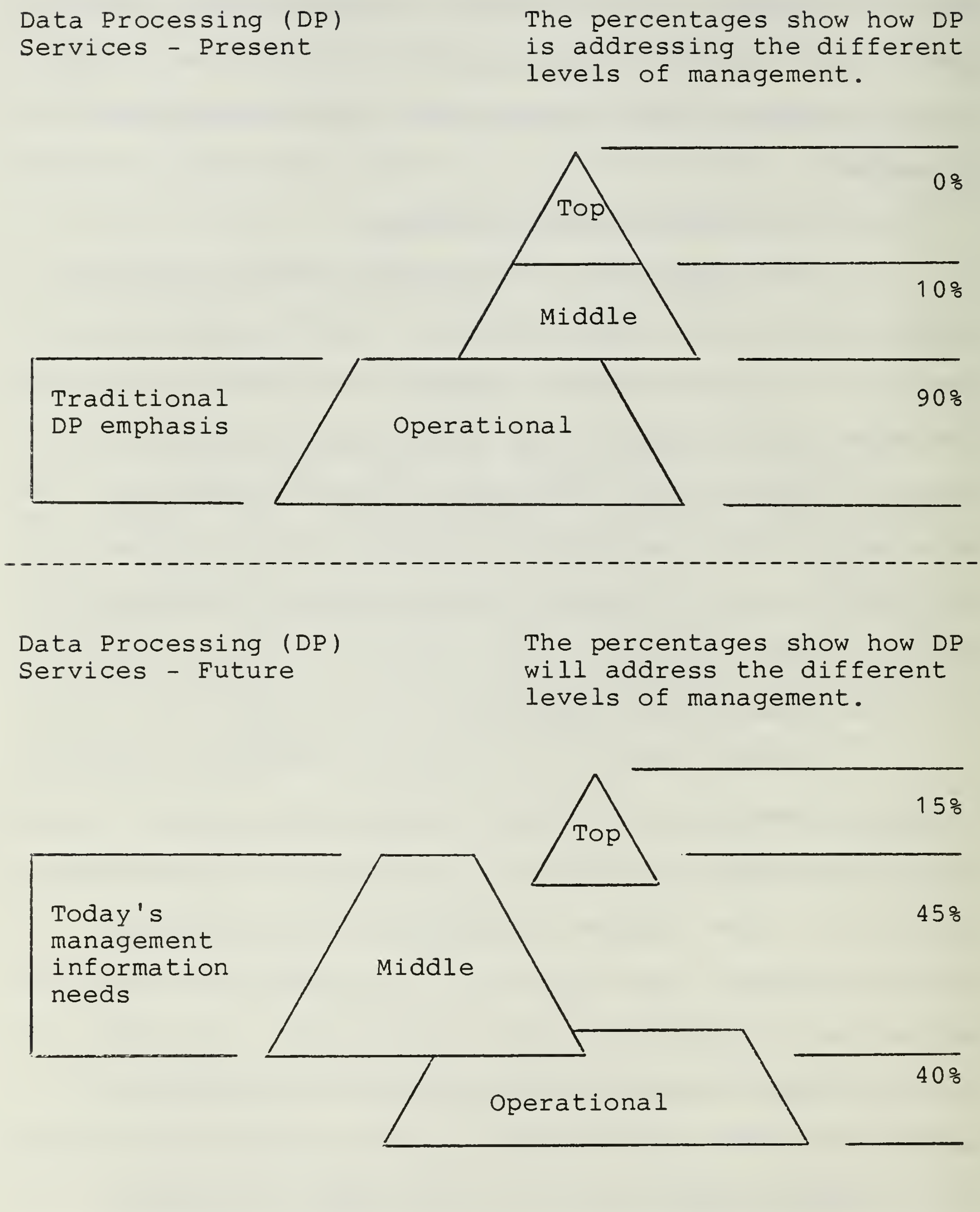


Figure 4. Data Processing Trends

fulfill their data processing needs. It also emphasizes the future importance of ICs since they mainly support top and middle management. This concept can help provide an estimate of the number of users.

d. User Needs Analysis

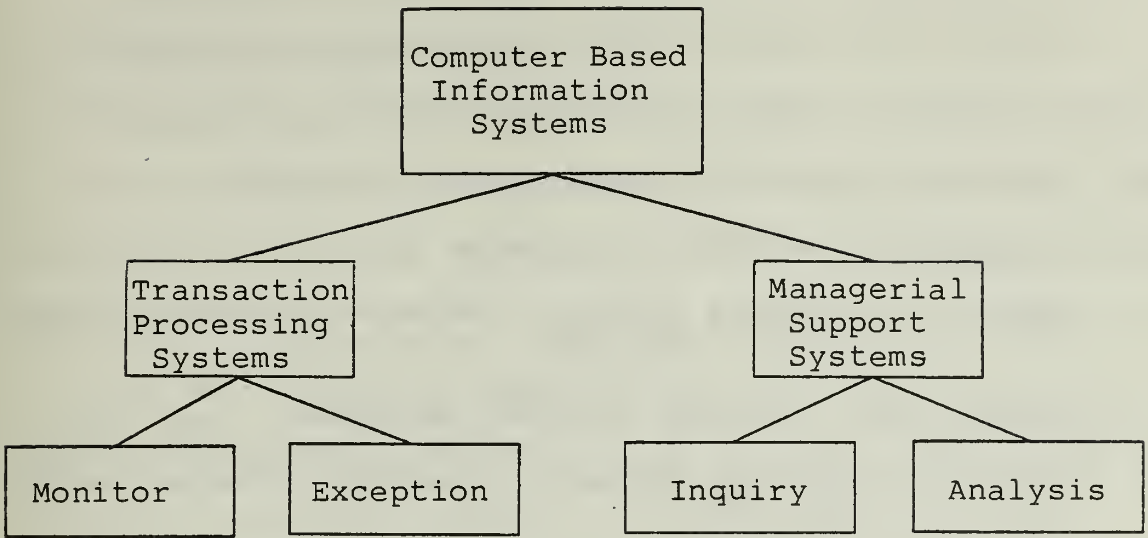
All information needs should be identified. This may seem like extraneous work, but in the end it will save time and will help to coordinate and integrate the requirements of diverse groups within the organization or corporation. This avoids duplication, provides a universal picture of the organization's needs, provides a vehicle for a more complete analysis, and provides a more accurate format for needs prioritization. It is important to concentrate on scope rather than level of abstraction or amount of detail. The latter is dependent on corporation size, automation maturity, and other considerations. Once these needs have been determined, the current methods for meeting these needs must be identified. In some cases these methods will be manual; in other cases they will automated. It is quite possible that they will not have been addressed at all or have been addressed in a deficient manner. Determination of needs is difficult to do well because of the high degree of subjectivity and a requirement to be creative. Nevertheless, extra time spent in this activity will reduce the number of corrections and facilitate revisions during the SDLC.

Although each implementation of the IC concept is different, user needs can be categorized in general terms. These needs are segregated into system types by Robert M. Alloway and Judith A. Quillard in Figure 5 [Ref. 38: p. 30]. The types of requirements commonly served by ICs are listed in Figure 5 under the categories of inquiry and analysis under the managerial support systems. The transaction processing system supports the lowest level of the previously mentioned managerial pyramid, the operational level which is generally not supported by an IC.

C. FEASIBILITY STUDY

1. Purpose

The purpose of the feasibility study is to determine whether the new system (IC) should be developed, to develop alternative solutions, to recommend the best solution, and to provide a projected budget for the new system. It is a determination of whether a project is possible, practical, and realistic. The feasibility study is a miniature systems analysis study that builds on the results of the initial investigation. It covers essentially the same ground as the analysis and general design phase, but in far less depth. [Ref. 39: pp. 120-145]



*Accounts Payable	*Accounts Receivable	*Ad-hoc Requests	*DSS
*Inventory	*Budget Variances	*Flexible Reports	*Analytic Tools
*Order Entry	*Expedited P.O.s	*End-user Query	*Simula-tion

<u>Monitor</u> The system monitors daily detail activity producing standard reports on a fixed schedule (daily, weekly, or monthly).

<u>Exception</u> The system processes detail activity reports where the definition of exception conditions is fixed.

<u>Inquiry</u> The system provides a database with flexible inquiry capability, enabling managers to design and change their own monitoring and exception reports.

<u>Analysis</u> The system provides powerful data analysis capabilities (modeling, simulation, optimization or statistical routines) and the appropriate database to support managerial decision-making.

Figure 5. Description of Systems Types

2. Alternative Solutions

Since the initial investigation has been completed and the problem has been defined, solutions are now considered. Among the possibilities are the following:

a. Do nothing - Maintain the status quo.

b. Expand the existing system - Add more resources of the same type (people, equipment, software).

c. Contract-out - Pay for outside services.

d. Reorganize existing services - Decentralization is the most common occurrence.

e. Establish new policies - Often used to control micro proliferation.

f. Install an IC - This is the most that can possibly be done in terms of a new system, under this study.

3. The New System

The needs analysis conducted in the initial investigation is the source for this part of the SDLC. By now, a general idea of what the IC will entail should be formulated. The type of IC (ie. Host-Connected, Stand-Alone, Networked, or Mixed), should be identified. A rough idea of the size and contents of a physical site and the number of staff personnel should be decided. Approximate figures for number of users, IC usage rates, supply requirements, organizational location, costs, and benefits should be developed. The following categories of feasibility [Ref. 40: p. 122] should be addressed:

a. Financial feasibility

b. Operational feasibility

c. Technical feasibility

d. Schedule feasibility

e. Human factors feasibility

In determining overall feasibility, the old system must be considered. James C. Wetherbe, writes the following on this issue:

> In the excitement of implementing new technology, it is often easy to overlook certain capabilities or functionalities of the old technology and to leave them out of the new system. Such actions result in disillusionment with the new system and nostalgia for the the old system. Therefore, it is critical to conduct a thorough analysis of the old system before final design decisions are made on a new system. [Ref. 41: p. 128]

In terms of the IC, this means that the data processing department resources, host and microcomputer usage, software support, and manual procedures of the existing system are reviewed and considered.

4. Projected Budget

Part of the feasibility study is comprised of a cost/benefit analysis. This analysis provides input to the development of the projected budget. The projected budget should combine costs and time and result in financial milestones and a schedule of expenditure of funds. It is better for upper management and for future performance evaluation measurements, if a cost justification for the IC is developed.

D. RECOMMENDATION

The final requirement of the investigation phase is to make a general recommendation. This thesis assumes that the development of an IC is required and that it is the best solution. The recommendation should include a general description of the intended IC. A projected budget and a justification should accompany this description. The next phase of the SDLC requires a closer investigation of the IC solution.

IV. ANALYSIS AND GENERAL DESIGN PHASE

A. PURPOSE OF ANALYSIS AND GENERAL DESIGN PHASE

The purpose of the analysis and general design phase is to develop a more detailed understanding of the existing system, to establish a general design of the new system, to secure management and user approval, and to develop a plan for the next phase, detailed design and testing [Ref. 42: p. 238]. The analysis and general design phase consists of a review of the existing system and development of new system requirements, new system design, and a plan for detailed design and testing. Formation of the IC staff should begin during this phase so that staff personnel may assist with the SDLC study, help guide the IC's development, and to plan for their new roles. The IC staff should be advised, however, that it is possible that they will be required to return to their former positions should approval for implementation be denied.

B. EXISTING SYSTEM REVIEW

The purpose for reviewing the existing system is to build an understanding of the business goals, objectives, and functions involved in the application areas encompassed by the project. Emphasis is on development of a logical view of these areas of understanding. Although the physical

view can be of assistance in arriving at the logical view, it should not be confused with the logical view, even though the logical-physical boundaries may not be well defined. Also, neither view should be substituted for the other.

The existing system review should be a more detailed review of the analysis already conducted. This review should entail a review of available data, organizational climate, organizational placement of information systems, work station (terminal or microcomputer) employment and deployment, user and management satisfaction, existing policies and their effect, information constraints, existing information system strengths and weaknesses, report generation, existing technological capabilities (e.g. graphics, electronic mail, networks, fourth generation software, etc.), the degree of acceptance of information technology, the growth position of the corporation or organization, the personnel situation (competency, morale, interest, etc.), and any other aspect or item that could be of assistance in determination of the logical view of the existing information system.

This information is highly situation dependent and will vary greatly from one organization or corporation to another. One concept that does not seem to change in this environment is the experience of the organization or corporation in the assimilation of new technology. There has been considerable discussion and writing on the stages of

assimilation of technology. These stages have broad application to most organizations or corporations regardless of other differences. The stage hypothesis also explains some of the anomalies observed in the orderly growth of computer technology. In an article in EDP Analyzer [Ref. 43: p. 6], the following synopsis succinctly addresses this issue:

> Nolan's and Gibson's landmark 1974 paper [Ref. 44: pp. 76-88] observed that many organizations go through four stages in the introduction and assimilation of new technology. These are: Introduction, proliferation, control, and mature usage. During the proliferation stage, the idea catches on and spreads 'like wild fire,' until costs clearly get out of hand. In the third stage, control is exercised in order to contain the growth of costs. Finally, mature usage occurs in the fourth stage. An organization can be in several stages simultaneously, for different forms of technology.
>
> McKenney and McFarlan [Refs. 45: pp. 109-119, 46: pp. 145-156, 47: pp. 36-40, 70-73] discuss a somewhat modified version of the four stages (or 'phases,' as these authors prefer). Their four phases are: (1) identification and initial investment, (2) experimentation and learning, (3) management control, and (4) widespread technology transfer. This version of the four phases has the advantage, we believe, of casting the important second phase in a somewhat different light from Nolan and Gibson. Nolan and Gibson gave a negative name--proliferation--to this phrase, leaving the impression that users are being almost irresponsible by adopting the new technology too rapidly. McKenney and McFarlan point out that this is the stage when experimenting and learning take place--a trial and error phase. If too much control is exerted too soon, important new uses of the technology can be killed off. [Ref. 48: p. 6]

The concept of phased assimilation of technology is not only useful in understanding the existing system, but will also be a consideration in other segments of the SDLC.

Understanding the user and technology is only part of the work involved with reviewing the existing system. The

other part involves understanding top management's goals and objectives and how these goals and objectives fit into the existing structure. This often requires not only observation and interviews, but a keen ability to sort out superfluous and misleading information. System analysts and outside consultants can provide unbiased and unaffected analytical ability for this endeavor.

C. NEW SYSTEM REQUIREMENTS

The purpose of this activity is to develop a description and statement of the new system requirements in sufficient depth for user evaluation and approval. This usually results in the development of a user requirements specification. This document contains requirements that are satisfactory to the user and approved by the user. It also is common practice to establish priorities within this document because either development costs may make it impossible to implement every request or phased implementation may be recommended.

Development of systems requirements is a difficult task because the IC concept is relatively new, the technology in support of the IC is rapidly developing, the requirements are dependent on the situation which can be radically different from all other situations, and the approach to be taken in this endeavor is unclear and often untried. As a starting point, reexamination of Figure 5 can help to

determine what the IC can offer, before deciding what it should offer. The six options listed under managerial support systems in Figure 5 provide an excellent list of possible user requirements. Each one of these options, when used, should be tied to a specific function and one or more databases. The users of each of these combinations should also be identified. These groupings can be viewed as a requirements matrix of options, databases, and users. Any of the elements of this matrix may be repeated in the formation of these groupings.

A slightly different approach categorizes requirements by application size and development time. Figure 6 provides a list of these categories in relation to the overall view of information systems. The last three items in Figure 6 describe appropriate uses of an IC and provide a different perspective for developing IC requirements.

PATH	USER WAIT AVERAGE QUEUE
Traditional Life Cycle (TLC)	1-2+ years
Prototyping	6-18 months
Purchase Software	2-6 months
Small Systems Implementation (IC)	1-2 months
Ad Hoc Requests (IC)	1-2 days
Consulting for End-User Computing (IC)	1-2 hours

Figure 6. Alternate Service Paths [Ref. 49: p. 103]

It may be helpful to combine the perspectives of both Figures 5 and 6.

The requirements specification should tell the user what requirements the IC will satisfy. These requirements are not stated in physical terms but rather in the logical terms mentioned earlier. An example of a physical requirement is to provide a terminal or microcomputer to every person in the accounting division. An example of a logical requirement is to provide all supervisors in the accounting division query access to the general ledger database for report generation and statistical analysis. Because IC technology is new, gaining popularity, and easy to relate to, the tendency is to want to rush to a decision and select equipment and software before the requirements are defined. This should be avoided.

The uniqueness of the IC, as compared to other systems development projects, requires that service requirements also be identified. Determination of the need for the IC to provide these services should be reviewed. Considerations may be training, consulting, programming support, application systems development, hardware and software procurement and testing, equipment maintenance, configuration control of hardware and software, vendor interfacing, obtaining group discounts, assistance in user cost/benefit analyses and justification studies, product demonstrations, newsletter publishings, supporting user groups, network control and

assistance, database interfacing, data extract services, security, data integrity, backup and recovery services, installation and setup of hardware and software, provision and availability of manuals and documentation, consumable supplies (e.g. printer paper and ribbons, diskettes, diskette holders, labels, etc.), procurement of computer furniture, timesharing services, electronic mail coordination, office automation control and implementation, providing hot line services, applications libraries, standards and compatibility management, marketing services, site licenses for software, microcomputer loan services, mainframe performance monitoring, planning assistance, and anything else that may be appropriate. Because of the different user responses to services, the requirements for some of these services may be indeterminable until actual installation and usage has occurred. The level and quantity of services may also be difficult to estimate before their provision.

D. NEW SYSTEM DESIGN

The purpose of new system design is to provide sufficient information to serve as a basis for a decision on whether to continue with implementation. The feasibility analysis is updated, and user and management commitment and approval are secured. The life cycle structure precludes full technical design during this activity, partly because this level of commitment has neither been made nor funded.

This activity results in a new systems design specification and an updated feasibility study. The latter includes preparation of accurate estimates for all five dimensions of feasibility--financial, technical, operational, scheduling, and human factors. Controls are also considered to assure accuracy, completeness, reliability, and quality of results produced. [Ref. 50: pp. 457-487]

The separation of general design from detailed design is often unclear. One guide to determine what to consider under general design is to determine if a more detailed level exists beyond the one under consideration. Another guide is to determine if further detail is necessary to more accurately determine feasibility in order to make a decision on IC implementation. Regardless of how one ascertains the level of detail, the question of how to proceed still exists. There is no single methodology for this process.

One way to proceed is to start with an overall review of the requirements. Since the requirements should have been developed with the business goals and objectives in mind, it seems logical to review these goals and objectives again. The IC goals and objectives should also be examined. Some examples of reasonable goals are to:

1. maximize end user productivity;
2. reduce the application backlog pressure;
3. control the proliferation of microcomputers;
4. educate the user about data processing;

5. to improve the relationship between data processing and the user;

6. reduce the amount of data and increase the amount of information;

7. encourage an entrepreneurial attitude towards users;

8. restructure the data processing organization; or,

9. for any other acceptable reason.

The user requirements are then matched to design requirements. For example, if a spreadsheet analysis capability is required, then the general design should determine the number and location of immediate or potential users, the type and amount of data to be accessed, the data access requirements, the requirements for integration with other software, the location of the data, and the sophistication required of the spreadsheet software. This should then result in a general design that supports either mainframe or micro implementation using either an integrated or stand-alone software package that should or should not be networked to other systems. Choosing the exact type of spreadsheet software would not be appropriate for this level of design and should be determined during detailed design.

This example illustrates the interrelationships of some of the various facets of the general design problem and gives some indication of the complexity involved and the vast number of options available. It is important to try to satisfy the important user requirements first. This priority should be based on corporate goals and objectives.

There will most likely be some design tradeoffs and decisions that must be made. These decisions are more effectively made at this design stage rather than at the detailed design stage where mistakes are more costly.

The result of this activity is a general design specification and a more accurate and detailed feasibility study. These documents form the basis for management, user, and IC implementation personnel approval.

E. DETAILED DESIGN AND TESTING PLANNING

The purpose of this activity is to establish a preliminary plan for the next phase, the detailed design and testing phase, and to recommend a general approach for testing the newly designed IC. This plan should provide a general guideline to determine which areas require further detail and to determine the level of detail required. This plan should also provide a general overview of the testing activity and should result in establishment of general acceptance standards and the framework for the type of testing to be conducted. One objective of this plan is to eliminate as many surprises as possible during development in order to eliminate surprises after development. Another objective of this plan is to ensure that major items are not overlooked.

There are two areas of consideration for the detailed design and testing plan. The first area concerns the identification of the items which require additional detail.

The level of detail will depend on the requirements of the problem, the size of the planned IC, the amount of risk involved, and the experience of the development team. The second area concerns the method to be used to test the new design. In most IC implementations a prototype, a pilot study, or a similar test vehicle should be utilized. This allows experimentation under controlled conditions. It also reduces end user frustration when the IC begins to operate, because operational problems should have surfaced and should have been eliminated during the testing phase. This plan should make transition from design to testing easier.

V. DETAILED DESIGN AND TESTING PHASE

A. PURPOSE OF DETAILED DESIGN AND TESTING PHASE

The purpose of the detailed design and testing phase is to turn specifications into a developed ready-to-use system that is completely documented, fully tested, and approved by users and management. This phase involves technical design, performance specification and measurement planning, staffing, prototyping and system testing, and general implementation planning.

B. TECHNICAL DESIGN

The purpose of the technical design activity is to expand the general design of the previous phase to a deeper, more detailed level. This activity results in a design specification that is as complete and detailed as possible. Technical design identifies the actual hardware and software, the physical layout, services to be offered, communications architecture, database configuration, administration, controls, and management structure. Technical design can be thought of as answering detailed "what" questions. The "how" questions are reserved for the next phase, installation and implementation.

One of the easiest technical design tasks is the identification of the actual hardware and software. Vendors are

usually very accommodating in providing information. Most of the larger vendors are also willing to let organizations and corporations use both hardware and software on a trial basis. In most cases it is fairly easy to survey current users of these products to determine their level of satisfaction. These users can provide information on vendor performance and response and on the benefits and drawbacks of the product they are using.

The detailed physical layout should, at a minimum, include blueprints of the floor layout. These blueprints should address not only furniture placement, but also power requirements, lighting, work flow, noise levels, ergonomic factors, safety, security, and comfort. Current literature stresses a separate training facility for classroom type training, location of consultants in close proximity to each other to enhance intra-staff communication, adequate noise control around work stations, provision of adequate space for administration requirements (i.e. supplies storage, equipment processing and repair, etc.), and a work station for each staff member. The location of the IC has a lot to do with the layout considerations and should also be determined during this phase of the SDLC. N. Dean Meyer, a consultant in advanced automation, writes the following about the location of the IC:

> The physical location of the information center is another critical management issue. It can be located within the offices of the information staff or placed in an area

occupied by end users. Space in the information staff's offices is usually easier to acquire than space in end-user quarters; however, that makes the center less accessible to users, requiring greater initiative on their part. [Ref. 51: p. 19]

The services that the IC will provide should be identified in the detailed design specification. The administration of these services should be a function of the next phase, the installation and implementation phase. The following list contains some of the services often provided by ICs:

1. training in the utilization of hardware and software
2. consultation on hardware and software problems
3. equipment maintenance, repair, and acquisition
4. vendor interface (group discounts)
5. software and hardware configuration control
6. loan out of hardware and software
7. newsletter publication
8. software, documentation, and publications library
9. users group coordination
10. product demonstrations (hardware and software)
11. database extracts
12. clearinghouse for all data processing requests

Design of the communications architecture mainly concerns outlining the various connections and methods of connection between devices. This would include network design, time share service, micro-mainframe interfaces, and office

automation design. The placement of protocol converters and the type of protocol conversion would also be included.

Technical design also involves the database configuration. Conversion of files to databases, combining and separating of databases, design of user access, location of databases (both in a hardware and software sense), creation of database extracts, data integrity, and data security are all detailed design considerations.

Administration, controls, and management are dependent on the situation. These three categories contain miscellaneous items not already included. For these reasons, items in the three categories are more obscure and sometimes difficult to place between this phase and the next phase.

C. PERFORMANCE SPECIFICATION AND MEASUREMENT PLANNING

Quite often the IC is required to prove its profitability. This can only be accomplished if there is some measure of performance and return on investment. Therefore, it will be necessary to determine what items are to be measured and to gather baseline data before the IC is implemented. If the performance standard and baseline measurement have not already been established, they should be established at this point in the SDLC study. This also helps to identify any additional design characteristics which may have been overlooked or misunderstood.

In many cases there is no requirement for the IC to justify its existence. It seems that many ICs have shown such astronomical returns on investment that upper management is not even interested in cost/benefit studies or proof of success. Most of these types of ICs have concentrated on the use of microcomputers. The following testimonials confirm this situation:

> Even after only two years, Signode's (Signode Industries) information center has had no trouble continuing to justify its existence to upper management. "We give presentations to management explaining what we are and what we're trying to do," he (John Nylen, IC supervisor) says, "then we bring in end users to tell what they've done. Just from that, management can see that, while it's often very difficult to figure hard dollar savings on this type of program, it is so successful and so completely integrated into our business that we can't do without it," he says. "People need the information they can get with our tools to make the decisions necessary to run their portion of the business. We are no longer expendable." [Ref. 52: p. 27]

> "I haven't had to justify the information center budget, amazingly enough," John Lucas (IC manager for Dennison Manufacturing Company) said. "I'm prepared to do it. The return is so obvious that they (management) haven't felt it necessary." [Ref. 53: p.73]

> A sampling of IC applications supports the argument that a solid business case exists for their implementation. At one company, ad hoc applications showed a productivity improvement factor--defined as the effort without the IC compared to that with the IC--ranging from threefold to more than a hundredfold. At the same time, return rates of repetitive applications ranged from 50 to several thousand percent. For some of these applications, a one-time use of an application more than paid for its development. [Ref. 54: pp. 18-19]

> "When we do a cost justification for a micro installation, we always look for a payback of not more than three years," (Karen) White (IC supervisor for California State Automobile Association) says, "but some of our paybacks have been more like two to three months!" [Ref. 55: p. 60]

Although the above quotations illustrate the bright side of IC justification, there is a dark side as well. Managers will sometimes be faced with expenses that were not expected or were larger than estimated. The following quotations explain:

> The hidden costs of using personal computers don't really involve unknown, inexplicable processes or gadgets either. Most every hidden cost is a rather mundane and predictable necessity....For large corporations hidden personal computing costs could be a six-figure tab for rewiring and construction work or another big bill for the cost of replacing obsolete computers with newer, more practical systems. [Ref. 56: pp. 122-123]

> To facilitate installation of the Wangnet cable throughout the New York Exchange's buildings, (Jerry) Burden (manager of office automation systems for the New York Stock Exchange) eventually had to spend more than $500,000. "The component cable of Wangnet only cost about $20,000," he says. "The rest of the money went to architects, construction workers and contractors. Every time we wanted to put in cable, we had to rip up parts of the building and draw up new plans and pay for new construction." [Ref. 57: p. 127]

> In the first year of operation, a personal computer purchased for about $2500 may run up thousands of dollars in additional costs, suggests Richard Dalton, the president of Keep/Track Systems, a San Francisco computer consulting firm...."The actual costs of operating a computer is frightening for people who expected their spending to end after their initial purchase," Dalton says. "Sometimes people can't believe they spent $10,000 for a computer in the first year. These costs are pretty damned insidious. They creep up on you without notice." [Ref. 58: p. 123]

> Sneider, who is an accountant (for Laventhal and Horwath), not a data-processing expert, points out that the purchase price of an individual computer isn't great in and of itself, but add a number of them together and you've got a significant investment. Thus allocation and efficient use are becoming important. [Ref. 59: p. 73]

Most organizations will use established standard performance measurements which can be employed as is or with

minor modifications. The difference with ICs is that many corporations or organizations find themselves operating in stage two of technology assimilation. If controls are instituted during this stage, then interest is stifled and end user computing will most likely stall. This concept is treated well in the following quotation:

> Since it (end user computing) is a relatively new area, past practices may not meet the needs. A key point seems to be: Recognize that phase two in end user computing is a period of experimentation and learning, and is not the time to be exerting tight controls. The basic decision of whether (and how much) to <u>encourage</u> versus <u>constrain</u> end user computing clearly should be made by executive management, and this decision will affect the plans on how to support end user computing. Hopefully, executive management will come to appreciate the nuances of the issues involved. [Ref. 60: p. 12]

A solution used by some organizations is to treat end user computing like a research and development project where temporary losses are accepted because the end result may be high yield on investment.

D. STAFFING

Staffing is one of the most critical issues for the success of the IC concept. Although some staff positions will have been filled already, consideration of the other staff positions is necessary. At a minimum there should be an IC manager. The IC manager should be tasked with responsibilities commensurate with the design of the IC. Usually, he has overall responsibility. John Seymour, president of Information Center Sciences, Incorporated (a consulting

firm) writes the following about the IC manager's responsibilities:

> The manager of this function (the IC) has got to understand the scope of the problems, the financial and system impacts of the marriage of two worlds. He or she has to see where controls are necessary and where they stifle objectives. While apparently serving the needs of personal computer users, the manager must be in touch with the large-scale issues: communications, data access, security, support, and much more. [Ref. 61: p. 31]

If the IC is designed as a profit center, this authority may be quite extensive. On the other hand, if the IC manager gets strong guidance from a steering committee then his decision making authority will be minimal. Use of a steering committee as a controlling force should be considered during this phase. The makeup of that committee should also be determined. One type of committee composition puts the users in charge. The following is an example of such an installation:

> "At Gulf (Research and Development Corporation), the [information center] is split between the central staff and respective user areas," Sam Defazio noted. "Through a steering committee, the beneficiaries of the technology really 'own' the information center while Systems Development provides day-to-day operations," he said. [Ref. 62: p. 131]

Steering committees may be chaired by top management, someone from the data processing department, someone from the management information department, user personnel, the IC manager, or other IC staff members. Major decision authority should also be decided and delineated before implementation. Other IC positions may include trainer, consultant,

systems analyst, secretary, administrative assistant, publisher, and purchasing agent. Quite often staff members will be tasked with the responsibilities of two or more of these positions as indicated in the following quotation:

> Each member of the CSC team (IC staff), including the leader, or coordinator, supports one or more tools and provides backup in others. The secretary also gets involved by teaching word processing and answering technical questions about several of the tools. [Ref. 63: 138]

The selection and recruitment of personnel, however, is a function of the next phase.

The IC staff must interface with all types of people with varying degrees of interest and varying abilities. A common theme throughout the current literature is that the staff members need to have training and consulting skills more than they do computer skills. The idea is that it is easier to train a skilled teacher about computers than it is to train a computer expert about teaching and customer rapport. The design of ICs must reflect not only this fact but the following fact as well:

> Needless to say, qualified candidates for the CSC team (IC staff) are scarce. Because of their excellent qualifications and the diverse experience gained from being part of the CSC team (IC staff), these people are highly marketable to other organizations. Consequently, the CSC (IC) has seen extensive staff turnover. Four people from the team have moved on to other assignments in less than two years. Consider the impact of a 75% or 100% turnover in a high performance team and how to manage for it. [Ref. 64: p. 140]

One concept that may help the situation described above is that of providing a career path for IC staff. While some

publications claim that the IC is a dead-end position, others claim it is an excellent place to get exposure to other people in the organization and can be a stepping stone to a better position in the corporation or organization. That notwithstanding, Daniel Couger, a professor of computer management at the University of Colorado College of Business, has outlined a career path for computer professionals that shows how the IC staff can progress in an organization. This career path is reproduced in Figure 7 [Ref. 65: p. 109]. In it he shows where the IC supervisor can become the information systems manager or can become a user manager.

E. PROTOTYPING AND SYSTEM TESTING

The purpose of prototyping and system testing is to ensure that what has been planned will work and to provide an opportunity to make any last minute changes before implementation. This is important. An article from Datamation magazine supports this statement in the following quotation:

> This (advice comes) from an IBMer who has been involved with some big (information) centers in California: "Make sure all the (information) center's major start up problems are ironed out before the user ever walks through the door. If the user senses the (information) center still has problems, it will add to his apprehension and may cause him to bolt and run." [Ref. 66: p. 32]

There is more than one way to ensure the smooth operation of the IC before implementation. One method is to not do anymore than a paper review. Although this is not

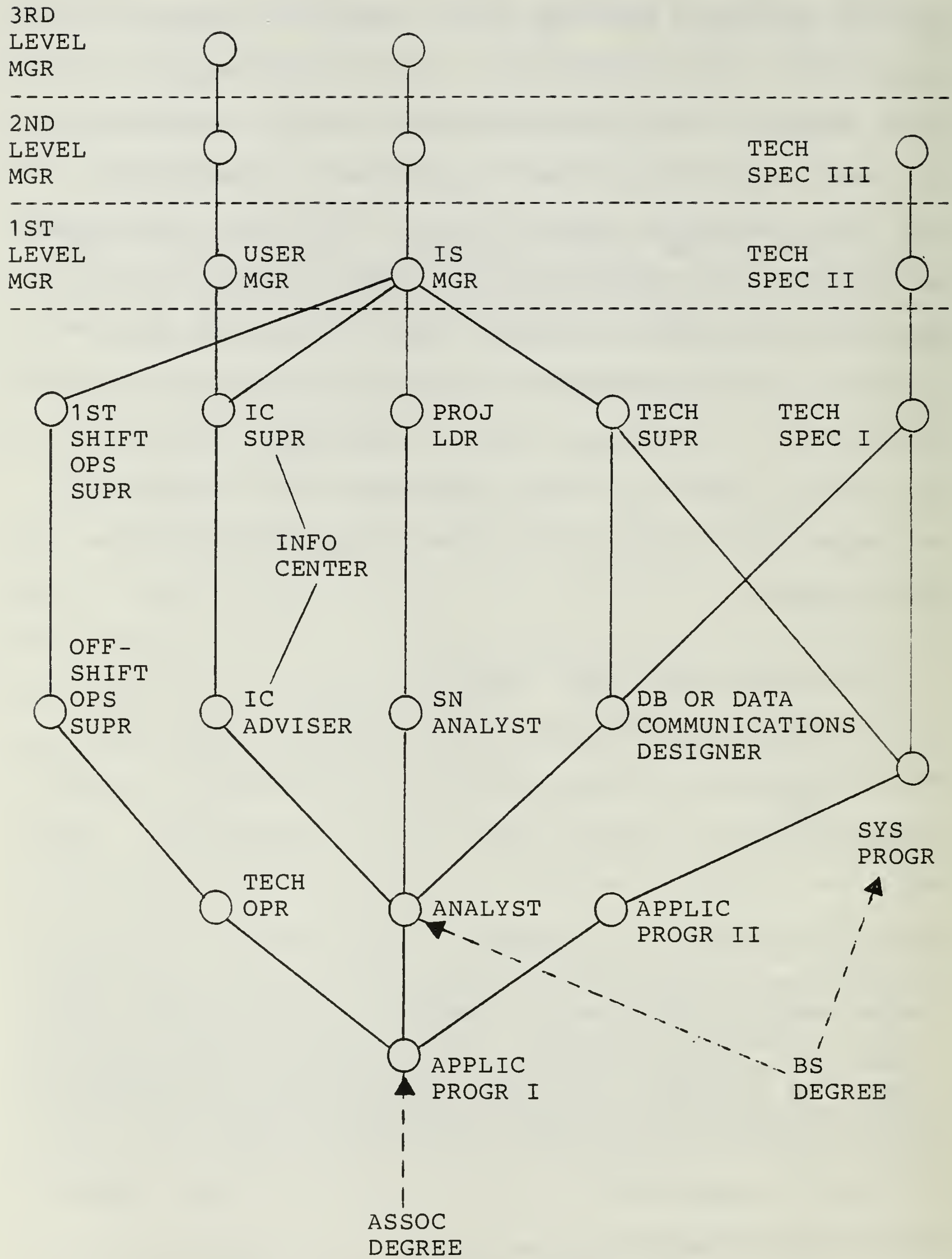


Figure 7. Career Paths of Computer Professionals

usually recommended, in some cases it is appropriate. The most common case is for the simple IC that provides minimal service. A more normal situation requires some degree of testing. In a more universal view of the IC, John P. Murray writes: "The development of the information center process is an evolutionary process that, in order to be most effective, should be done in phases." [Ref. 67: p. 37] The first phase is the prototyping or testing phase.

Although prototyping is the method most often mentioned in the literature, there are other methods to test the operation of the IC. In reality, these other methods are either partial implementations of a prototype IC or they are full implementations of a partial prototype. Therefore, only the full prototype method will be discussed in this thesis.

Testing an IC prototype is the same thing as conducting an IC pilot study. There have been a sufficient number of IC pilot studies conducted to provide some insight into how they should be conducted. John Mele, product support specialist at K-Mart Apparel Corporation, has been paraphrased as having said the following:

> A pilot project for the fledgling information center should be identified, he said. Ideally, the project should be in an area in which automation can provide tangible and measurable benefits. Look for a department that is swamped with work, has mostly manual systems in place and is receptive to the idea of computerization. Too many promises should not be offered at the outset, he stressed. [Ref. 68: p. 23]

Another article by Steve Hearn, manager of management support services for ARCO Petroleum Products Company, gives his estimate of the length of time needed for the pilot study:

> The length of the pilot varies, depending of the preparation needed to begin support of the first user. Once the first user is trained, approximately three months should be sufficient to assess whether a long-term commitment should be made to the IC concept. [Ref. 69: p. 22]

Because the IC concept is so unusual, the steps required to implement a pilot study may not be intuitively obvious. For this reason, the following quoted material has been taken from an article by Marsha Seidman, president of Crwth Computer Coursewares [Ref. 70: p. 9]:

> A successful pilot is usually the direct result of careful planning, involving the systems resources as well as knowledgeable product consultants. Several pilots have failed because of slow response time or lack of terminals. In one case, a lack of DASD (Direct Access Storage Device) space prohibited the installation of a fourth generation language. Here are the steps for implementing a pilot:
>
> 1. Plan your system resources in advance: terminals, DASD space, CPU use, user IDs.
>
> 2. Select a user department committed to the concept of end user computing.
>
> 3. Choose a small group of highly motivated business professionals from the department.
>
> 4. Select a fourth generation language.
>
> 5. Train an information center consultant as a product specialist.
>
> 6. Train the business professionals in the use of the language.
>
> 7. Define objectives and the range of acceptance criteria that will determine the success of your pilot.

After the pilot study has proven to be a success, the usual admonitions apply. Be careful to not overextend the resources or the abilities of the IC staff or of the installed hardware and software. Also be reasonably sure that the success of the IC can be duplicated in the full system environment. There would be nothing more embarrassing than to realize that the reason the pilot was a success was due to special circumstances and extra attention and that the production IC is a failure. It also might prove very costly to make such a mistake.

F. GENERAL IMPLEMENTATION PLANNING

In keeping with the SDLC methodology, the end of this phase is in reality the precursor to the next phase, the installation and implementation phase. Even before the pilot study is complete, a general plan for the next phase should be developed. This plan should cover general items that will need to be instituted. The benefit of this activity is that it provides the opportunity to identify actions that must be instituted before this phase ends and allows for a better transition from pilot study to full operation.

Additional equipment, hardware, software, documentation, and supplies should be identified. Likewise, additional procedures and policies should be disseminated. Finally, general spreading of the word and mass education of

potential users should be considered so as to avoid any more complications than absolutely necessary.

VI. INSTALLATION AND IMPLEMENTATION PHASE

A. PURPOSE OF INSTALLATION AND IMPLEMENTATION PHASE

The purpose of the installation and implementation phase is to transit from the present system to the new system and to get the new system functioning as a productive and successful entity. This phase results in the most detailed breakdown of the areas dealt with in the previous phases. If a pilot study was conducted, this phase puts into practice the lessons learned from that study. It is recommended that this phase follow the concepts presented earlier, especially that of incremental implementation.

It would be virtually impossible to enumerate all of the considerations that should be mentioned in this phase of the IC implementation. Also, due to the nature of the SDLC study, most of the major items have already been covered. Therefore, this chapter will concentrate more on the unusual, innovative, and important detailed items that contribute to a successful transition and implementation. These items are categorized in an attempt to provide a logical approach for a more complete installation and implementation. For an IC, installation refers to putting the equipment and software in place. The manager tasked with this responsibility is assumed to have the necessary skills to accomplish this job. IC implementation, however, requires

special knowledge not ordinarily encountered by managers. Therefore, the remainder of this chapter will concern only implementation factors.

B. INTRODUCTION

Organizations tend to solve problems in unique ways. Implementing an IC is one of those problems that is subject to the peculiarities of these individual organizations. In some cases what one organization may call a success, another organization may call a failure. If this diversity is kept in mind, then what follows will make more sense.

In an attempt to capture the overall essence of this phase, the first concept to be covered as part of this introduction is the idea of success. One author writes:

> The success of an information center depends on a service and entrepreneurial orientation, the right tools, the right people, a supportive climate, justification by the end user and data availability and integrity. With such factors going for it, the chance of success greatly increases. [Ref. 71: p. 141]

This entrepreneurial orientation is sufficiently explained by the following two quotations:

> He (Ray Youstra of IBM) said the information center should be run as a business within a business, complete with marketing, measurements and a board of directors. "You must report back to someone high up in the organization, not just the DP manager." [Ref. 72: p. 22]

> As the information center begins to expand and promote its services, the DP manager must remain involved, setting directions and defining and monitoring objectives while also permitting the center to experiment, adjust through user feedback and innovate. The staff should be encouraged to work directly with user personnel, treating them as customers and responding immediately to their problems

> while researching new techniques and tools to meet their needs. [Ref. 73: p. 27]

Success, however, is sometimes attained by learning from failure or mistakes. For completeness, information should be sought on both successes and failures. The following illustration lists one manager's mistakes, and offers several good points for IC implementation:

> IC manager Joe Bochino (of European American Bank) reports that if he had to do it all over, he would do a few things differently. He would take more time to educate the IC staff--teaching two or three people the entire operation instead of the whole staff piece-by-piece. He would make a separate processor available to the IC as soon as the pilot project was completed, instead of having to wait nine months as he did. He would have the data delivery methodology in place. He would better coordinate the personal computer, time sharing and mainframe disciplines under a single manager. He would guarantee availability of technical expertise by having a systems programmer report directly to the IC. And he would ensure that the IC did not start on a shoestring, and that it offered users secretarial and administrative as well as information support. [Ref. 74: p. 46]

Tough decisions need to be made in the development of a successful IC. Some of these decisions will be discussed in the remainder of this chapter. The toughness of these decisions becomes apparent when one begins to appreciate the enormity of the task at hand. This enormity is expressed in the following statement made over a year ago about the number of available microcomputers and their associated software:

> There are 675 micro hardware products on the market today (December 1983) and 154 manufacturers, according to IRD (International Resource Development, Incorporated). The microcomputer has hit the industry with a force strong enough to support some 100 microcomputer publications and

employ countless third-party software developers. [Ref. 75: p. 16]

The IC manager who tries to support the hardware and software already in place, in the organization, may be facing a problem that has no economical solution. In addition to support problems, technical problems such as compatibility may be just as difficult to solve. Even more disheartening is the fact that many of the remaining responsibilities of the IC can also be tough to manage. These problems can only get worse if ignored. Therefore, developing the IC as soon as possible, harnessing the potential of end user computing, and controlling incompatibility often make good business sense.

C. MARKETING

The concept behind marketing is that the end users need to understand the IC: what it is, what it can do for them, and how it operates. The users need to be convinced that the IC is a better solution for end user computing and that it is not a repository for more backlogs and more user frustration. On the other hand, the IC staff needs "to promote existing capabilities without promoting new business that would require additional staff and facilities to support." [Ref. 76: p. 23] There is, however, an argument against the need for marketing. The following two quotations support this argument:

> Once you've started up (the IC), you've got to fight damn hard to keep your credibility. If you're any good at all, you'll be overwhelmed with customers--they'll do your advertising for you. [Ref. 77: p. 9]

> If anything, our biggest problem was holding users back in order to keep from swamping our initial [information center] resources. We have 1800 potential end users, half of whom currently have access to the computer. [Ref. 78: p. 34]

Nevertheless, for many organizations, there are reasons to consider some form of marketing for the IC. One reason is to dispel unrealistic user expectations. In an article written by Robert C. Tesch, Sr. and Debbie B. Tesch, the issue of user expectations for management information systems is discussed. These researchers provide some insight into the importance of user expectations with the following:

> In (Michael J.) Ginzberg's study ("Early Diagnosis of MIS Implementation Failure: Promising Results and Unanswered Questions," Management Science, April 1981), results suggest that users who hold realistic expectations prior to implementation are more satisfied with the system and use it more than users whose pre-implementation expectations are unrealistic. Ginzberg identifies five areas of expectations important in determining user's response to MIS:
>
> 1. Reason for developing the system
> 2. Importance of the problem being addressed
> 3. The way the system will be used
> 4. Systems impact on the organization
> 5. Criteria used to evaluate the system. [Ref. 79: p. 64]

Marketing can also be of assistance in reducing internal conflict resulting from miscommunication and misconceptions. One common misconception is that technology always replaces people. This fear of people losing their jobs can be very

damaging if not controlled. Miscommunications are also common. The following example represents a miscommunication situation that could have been successfully handled much earlier had some form of marketing been considered:

> "Be sensitive to the possibility of conflicts," warns Jim DeLong, a supervisor in the information center of the Michigan Wisconsin Pipe Line Co., Detroit. "We weren't, and we alienated our own people. They'd say things like, 'What are you doing talking to our users?' Some called us the 'misinformation center' for awhile."...The information center staff recently held a meeting to explain their program to colleagues in other MIS sectors, and hash out differences. DeLong wishes they'd met a year earlier, before the center went into operation. [Ref. 80: p. 72]

The following quotation shows another situation that needed some form of marketing support:

> "I (an information center manager) don't understand what's happening to our Information Center. The pilot was a great success, but when we opened our doors to end users it flopped. We're all set up to offer our services, but no one's buying." [Ref. 81: p. 53]

Another insight in favor of marketing is provided by Gary Livingston, president of Information and Strategic Planning Professionals in Lakewood, Ohio:

> Managers shouldn't become too optimistic after achieving good initial results with the IC, warned Livingston; the strong beginning is usually due to the enthusiasm typical of pioneering users. After that it's slow going: "Thirty percent of the corporation, and 10 percent of top management, are laggards and resisters," he said. [Ref. 82: p. 14]

Marketing the IC, however, can be more extensive than the initial advertising of the IC's capabilities. It can extend to post-implementation support as well. It can involve detailed strategy and planning and can require

professional management or consultation. The whole marketing concept is neatly tied together in an article written by Marylin J. Richardson, in which she writes:

> Like any marketing strategy, one for an information center involves identifying the target market and then defining the appropriate product for that market; establishing where that product should be placed so the target market can (and will want to) access it; determining the price (people, time, and money) the target market can afford; and implementing a blend of promotional activities to communicate to the target market what the product is, how much it costs and where to get it. [Ref. 83: p. 17]

D. TRAINING

Training starts with the IC staff. Staff personnel must be trained before they are able to teach the users. Training staff personnel can be accomplished in any manner suitable to the circumstance or organization. One unusual method conducted by Michael Steinberg, the information specialist at Corning Glassworks, is explained as follows:

> "We have found the most effective way to train our consultants in the use of a product is to find a user who knows just about as little about the product as our new consultant does," one member (of the IC staff) says. "We sit them down with a couple of reference and training manuals and have them learn together to develop an application. We find this spending a whole day with a user is very effective in developing that extra sense, that intuition kind of thing about the package." [Ref. 84: p. 30]

Training the user is of equal or greater concern. It is too easy for users to choose an inappropriate software package for their application or even worse to misuse a software package. One executive using a spreadsheet package caused a $55 million sales figure to be in error by

$8 million [Ref. 85: p. 94]. Although in this case, the error was caught early enough not to cause any problem, the consequences could have been disastrous.

User training is also important because of the advantages it offers. One article claims "that users need sixty to eighty hours 'to figure out the computer on their own.'" [Ref. 86: p. 64] The same article states that this training can be accomplished in twenty hours through a commercial training workshop [Ref. 87: p. 64].

An even more sobering thought, is that users can not do it on their own. "Once new users are left alone with their computers, even the simplest questions can become major obstacles." [Ref. 88: p. 236] Therefore, not only is training important, but follow-on training support is just as important.

All end users do not need comprehensive training. It is important to identify the types of end users and to understand the different types of training that end users need. Dr. David J. Stang, Ph.D., partitions users into four categories [Ref. 89: p. 58]:

1. Non-Users (Never Have) - Those who never have used a micro (terminal), but will soon.

2. Non-Users (Never Will) - Those who will not be using micros (terminals).

3. Surface Users - Those who only want to use micros (terminals), not understand them.

4. Experienced Users - Those who understand and use micros (terminals).

The types of training are expressed by the following quotation:

> We see end users needing five types of training: (1) data processing concepts, (2) quick start, (3) refresher aids, (4) help in overcoming difficulties of advanced use, and (5) explanation of the assumptions behind the models they plan to use. [Ref. 90: p. 4]

These categories of end users and types of training offer both a method for understanding the training problem and a framework within which to operate. Use of these categories is left up to the reader.

Training is expensive. This point is clearly presented in the following two quotations:

> To get a good trainer these days, you may have to spend quite a bit. For an in-house person salaries have risen steadily in recent years--$24,300 (1979), $27,200 (1980), $29,300 (1981), to $31,900 (1982)--and probably continue to climb. But far more expensive than in-house training is an outside consultant, whose rates will range anywhere from $100 a day to $2,000 an hour. In short, training can be expensive, though perhaps not as expensive as the ignorance it can replace. [Ref. 91: p. 56]

> Ferrin (Corporation) has found that it can take anywhere from 20 to 100 hours for a person to get up to scratch on the basic operation of a single pc program, like a spreadsheet or database package. The company figures that the average cost to a corporation is $40 per hour per student, and the total learning cost can reach $800 to $4,000 for a single corporate pc user. There's also the added cost of the other people that get involved in helping users, such as department colleagues, in-house computer professionals, and outside organizations like Ferrin (a pc services firm). Ferrin calculates that additions like these can up the total learning cost to between $1,000 and $6,000 per user. And that's just for one package. [Ref. 92: p. 135]

Faced with expenses of this magnitude, one cannot help but wonder what are the training options. Although only one of the options mentioned in the following list will be

discussed in any detail, any one of these training options may be appropriate under the right circumstances [Ref. 93: p. 24]:

1. Formal classroom
2. One-on-one tutoring
3. Computer-based
4. Videotape-based
5. Interactive video disk
6. Independent study
7. Contractors

The one training option that will be discussed is option number 3, computer-based training (CBT). This option seems to meet more of the IC needs than any other. It is more effective than other methods, lends itself well to large user organizations, and has a strong capacity for simulation [Ref. 94: p.18]. CBT allows the user to become familiar with a software package by working through an interactive software program. This program will not only feature the kind of knowledge required to use a software package, but it will often be composed within the package it is designed to teach. It will often hand-walk the user through the package on the actual system that the user will be using. Most initial CBT packages were designed for mainframe end user computing, but more are becoming available for microcomputers as well. Some CBTs, called authoring systems, allow the organization to develop and modify the

training package to meet the specific needs of the organization. Other CBT packages are unalterable.

CBT is often the preferred method for training because of its centralized distribution, administration, and monitoring capabilities:

> It (CBT) easily accommodates changes in course material. It allows trainee performance to be centrally monitored and administrative records to be automatically updated. And it permits a high degree of interaction between student and system, according to Christopher Howey, a professor of instruction and training technology at Governors State University in Park Forest, Ill....it (CBT) lends itself well to large user organizations that have to disperse their instructional material to many employees over a wide geographic area, (Gary) Brown (vice-president of CRWTH Computer Coursewares, Inc.) said. [Ref. 95: p. 18]

> ...users can reportedly transmit CBT course material back and forth between their central and remote computing installations. From a user's standpoint, the advantage of having such an uploading and downloading capability is that it provides a "centralized means of managing instructional resources," according to professor Christopher Howey of Governors State University in Park Forest, Ill. "Large organizations need to be able to centrally store results so they can decide which employees are qualified to receive a particular type of training and which aren't."...In addition, CBT development tools may soon gain the ability to upload personal computer-generated courseware to a large-scale CPU, where the material would reside centrally as a "data file in a data base management system [DBMS]," (Gloria) Gery (vice-president) of the Courseware Developers, Inc., in Manchester, Conn.) predicted. If a stored lesson later required revisions, the owner would need merely to rewrite its one mainframe-resident copy and then could immediately distribute updated versions of the courseware to all remote end users. [Ref. 96: p. 22]

CBTs can save money by teaching users without requiring the services of a staff trainer. They are also more individualistic than the classroom environment and eliminate the

personality problems of one-on-one training. Nevertheless, there are some reasons for not using CBTs. One is that they cannot replace the human touch. But, until just recently, they had not been of very good quality. Gary DeWard Brown, executive vice president of Crwth Computer Coursewares, a CBT vendor, gives some guidance in this area:

> Combining instruction with hands-on experience, CBT is potentially the ideal vehicle for teaching end users computer skills. However, just because a course is presented through CBT does not guarantee effectiveness. The quality of a CBT course for end users will depend on the following three points [Ref. 97: p. 10]:
>
> 1. Does the course address the target audience?
>
> 2. Is the subject matter well presented?
>
> 3. Are the strengths of the medium fully exploited?

Of course, CBTs are more complicated than is suggested. The only sure way to ensure that a CBT meets the IC's needs is to use the CBT and form a judgment based on preference. There are two additional items worth mentioning when trying to evaluate a CBT. The first is the ratio of question screens to text screens. The current thought is that ideally the user would like to see a 1:1 ratio [Ref. 98: p. 15]. The second item is that a workbook can be a valuable asset to the casual user [Ref. 99: p. 32].

In creating CBTs for novice users, Gary DeWard Brown uses some assumptions about users that helps his company to develop a good product. These assumptions are paraphrased in the following list because they give a perspective

towards training users that may be helpful in the selection of the proper training method [Ref. 100: pp. 13-14]:

1. Users are intelligent.
2. Users have never used a computer before.
3. Users are interested, but impatient.
4. Users have a sense of humor.
5. Users will make mistakes.
6. Users need to understand some DP terms.
7. Users need to know when to use a computer and when not to use one.
8. Users need to know about security and backup.
9. Users need to know computing costs.

End user training is not without its problems. One of the most difficult problems to solve is how to satisfy the end user that has no patience. "'End users want to be able to learn enough to get up and going on their own projects in a day, a half-day if they can. And most would like to be able to learn it all in 30 minutes,' observes (Bob) Richter (IC consultant and trainer for Deltak, Inc.)." [Ref. 101: p. 50] Another problem concerns the user's capacity and desire to learn different software packages. Merlyn Vaughn, vice president and general manager of Systems Software Division of Walker Interactive Products, capsulizes this problem:

> It is unreasonable to an end user to learn several different products to meet his basic information management needs. While DP professionals might be used to frequent

> conversions and a multiplicity of human interfaces, the end-user will not tolerate such an unfriendly environment. Usually, the first tool learned will be the tool that the user will want to stick with, and with which he will wish to meet his needs....Information Centers that I have come across that have tried replacing several tools with fewer multi-purpose products, have found it difficult to wean their customers from the old tools, and the proliferation is compounded. [Ref. 102: pp. 28-29]

John Seymour provides a "pseudo" solution to the problem of weaning end users from the software packages already in place, by the following method:

> Don't try (to wean end users). Make the end users learn at least two of the spreadsheets available, or two of the word processors for starters. They may not want to use both, but the benefits are still positive. First, you get greater back-up, transferability of skills, and compatibility of knowledge. Second, the users by learning just one other package, broaden their overall capability and understanding enormously. [Ref. 103: p. 38]

Sharing the experiences of others is a powerful education tool. With this thought in mind, four quotations relate interesting training experiences of others:

> They (Inland Steel's IC) discovered, however, that day-to-day problems demanded time from the (information) center staff, and turned to computer-based training to clear staff for support to users....Now they (Inland Steel) have appointed one end user in each department to be a "user specialist," who gets advanced training and then supports between eight and 15 users in that department. [Ref. 104: p. 16]

> Training (at Exxon Corporation) is geared to clients' schedules. Courses are also designed to give a working knowledge of tools without turning clients into technical experts. Each course maximizes hands-on student exercises and minimizes lecture sessions, and no course is longer than one day. Each class is limited to four people, and for clients with seniority, classes are available on a one-on-one basis. There are no published class schedules--a class is taught when two or more clients have

requested it and an instructor is free. Waiting time to take a class is typically less than two weeks. [Ref. 105: p. 138]

Three end users from (Graco Incorporated's) marketing went back to their department after learning the basics of the system and immediately showed other department members how to access and use the applications they had built soon after the (three day) training session. In a matter of days, members of marketing were utilizing the information center service. [Ref. 106: p. 27]

"In the formative stage of an information center," says Richard Crandall, president, Comshare, Inc., Ann Arbor, MI, "it is feasible to handle the user training needs with one or a few instructors," using traditional classroom training. However, this method becomes impractical as two major developments occur. First, larger numbers of end users require training in even larger numbers of software products....(Second) There are more "occasional" computer users who require refresher courses at least once a year. [Ref. 107: p. 32]

E. STAFFING AND CONSULTING

Many IC staffing issues are commonly found in any staffing situation. Examples of these issues are the hiring of temporary help, hiring from inside the organization or from outside, and determination of skills required. There are, however, a few requirements that are peculiar to the IC. One is that the staff needs to have patience, good "tube-side" manner, and should be interested in end results rather than the technology that achieves it [Ref. 108: p. 28].

The important part of IC staffing revolves around the consultants. IC consultants are the main interface between end users and the IC. They need to be placed near the end users for convenient access [Ref. 109: p. 29]. The consultants need to guide the end users in the appropriate software

to use for the application and they need to support the data processing department and refer large applications to the data processing department. Exxon Corporation accomplishes this in the following manner:

> When clients come to the CSC (IC) for advice on a new application, a team member discusses the problem with them and evaluates how best to handle their needs. For straightforward applications, the CSC (IC) member simply recommends an approach or a tool. For more complex problems, a second CSC (IC) member is usually called in to help. If the application is complex enough to require contracting for conventional development by systems professionals, the client is directed to the appropriate people in other parts of the organization. [Ref. 110: p. 138]

Another important consideration is determination of the level of support to be offered. Although this is also situation dependent, it is generally thought that consultants should not program for the end users. Jeffrie Shelley, manager of the IC at the Chicago Transit Authority, claims that "The information center staff shouldn't do any coding, or it will develop its own backlog." [Ref. 111: p. 14] Those managers that do not object to consultants doing coding for end users, often place restrictions on coding so that consultants are only minimally involved. The majority of IC managers seem to follow the advice in the next two quotations:

> (Dennis) Mills (information center supervisor at John Deere Component Works) warns MIS/DP managers not to allow the IC to become a programming department for ad hoc or one time requests. If the IC is to achieve its original goals, questions that begin, "Can you do..." must be changed to "Will you help me...." [Ref. 112: p. 141]

> Information centers should limit their support activities to providing end users with in-house consulting services....(Warren) Brown (MIS director at Hercules Incorporated aerospace division) urged information center staff members to avoid intensive involvement in their clients' software development projects...."We don't create any deliverables," Brown said. "We're striving for user self-sufficiency. Our goal is to help users to help themselves." [Ref. 113: p. 10]

Since the availability of consultants and the consistency of their advice varies from organization to organization, some examples of how corporations treat these requirements have been provided:

> Because of its size and purpose, the CSC (IC at Exxon Corporation) does not write applications for its clients; that would not facilitate "end user" computing. And while CSC (IC) services are available on call, there is a four hour limit on consultation or technical assistance per application. This ensures that no single user monopolizes the center. [Ref. 114: p. 138]

> Two service consultants operate the walk-in facility from 8 am to 4:30 pm every working day, although employees can arrange to use the center 24 hours a day, seven days a week. The consultants conduct required introductory classes for center users and specialized courses in the various software tools. They also assist in designing initial applications and applying the tools. [Ref. 115: p. 28]

> To help ensure consistency and accuracy in consultations, the CSC (IC) team meets once a week to compare notes on significant recommendations. This meeting also enhances the team's education while preventing any one member from overselling the tool that he or she normally supports. [Ref. 116: p. 138]

The final issue to be considered in relationship to staffing and consulting is that of the required number of consultants. This number is usually expressed as the ratio of consultants to end users. Van Bakshi, an instructor with the IBM Information Systems Management Institute, claims

that "the average ratio of information center consultants to end users is about 1:35, with a ratio of 1:100 prevailing in the engineering world." [Ref. 117: p. 24] Vaughn Merlyn, from Walker Interactive Products, provides the following insight:

> Consultant-to-customer ratios depend upon many factors, including the type of customer, the tools, and the maturity of the Information Center. A good working number, for planning purposes, is around one consultant for every fifty users. However, there are many exceptions to this rule, particularly during the earlier stages of Information Center growth when a lower ratio is desirable. [Ref. 118: p. 27]

F. HARDWARE

Much has been written about IC hardware, especially microcomputers. Therefore, treatment of this topic will be light. At this level in the SDLC, policy and detail are important. Hardware can be helpful or it can hurt the IC, depending on the way it is controlled. If control is too tight few people will use the IC. If control is too loose, the IC will turn into a gigantic expense with little return on investment. There is no perfect amount of control. Again it is situationally dependent. A comparison between computing power and costs is made in the following article extract:

> On a large, heavily loaded computer running TSO, the incremental hardware cost to provide adequate response for five additional users might be $500,000. To give the same five users even better response with five micros would cost even less than $25,000, with a letter-quality printer thrown in for each. [Ref. 119: p. 96]

Although this is not a complete cost/benefit analysis it does provide a sample of some of the type of trade-offs that involve hardware in the IC. The high cost of IC hardware often causes frequent scrutiny and requires effective utilization. The following quotation addresses the effective utilization of personal computers:

> Giving a personal computer to someone who is not interested in one, regardless of whether or not the person falls into the targeted group, is flushing money down the drain....today's PCs require an interest high enough to get past the very frustrating and clumsy learning curves....On the other hand, denying one (PC) to someone aggressively interested, again regardless of targeted groups, is just as big a waste. If necessary, such people should be moved organizationally before they are flatly denied access. The aggressively interested employee will find productive uses for the PC that no one else dreamed of. [Ref. 120: pp. 35-36]

Some organizations are loaning microcomputers to employees to cover peak demand periods, as a backup for broken microcomputers, and as a means to test out a new piece of equipment [Refs. 121: p.15, 122: p. 82, 123: p. 16]. Some even are letting employees take microcomputers home [Refs. 124: p. 82, 125: p. 36].

One of the most talked about topics is personal computer compatibility. Compatible computers allow sharing of programs and data and can be connected for communication between themselves and mainframes. The degree of compatibility, which is often overlooked, needs to be examined more closely. The following excerpt explains:

> The unseen disease in the swift proliferation of personal computers is the complication of incompatible products

> that appear to be compatible. Suppose everyone in the organization had been carefully restricted to the IBM PC, LOTUS dBASE, and WORDPLUS. We're in great shape, right? But half of them are running under DOS Version 1, some under Version 1.25, and the rest under Version 2. Associated versions of the application products run on the appropriate machines. Some of the software has bugs that were fixed in later versions. Some use color, some don't. Some allow careful disk organization under subdirectories, some don't. But everyone is using the same products. Is a rose still a rose...? And this is the easy case where everyone is using one machine and one set of products. But the disks and files are not interchangeable, even here. [Ref. 126: p. 39]

At United Technologies Corporation, John Bennett, the DP director, describes a minimum compatibility policy as follows:

> Given this loose structure, there are no corporatewide preferred vendor lists, said Bennett, as each division has settled on the type of equipment that it feels is most beneficial. The only corporate policy is that the PC have a minimum of 256K bytes of RAM, a graphics card, printer and high resolution monitor. [Ref. 127: p. 51]

IC managers should be concerned with other hardware details as well. The IC should educate their end users on the proper care of diskettes (e.g., no bending, no touching the magnetic surface, use only felt tip pens to write on the labels, use backup procedures often, store backup copies off-site, and avoidance of magnetic objects) and other equipment. The IC should ensure adequate quality power is available, provide and teach security of equipment and data, and provide any other necessary guidance.

The IC manager should install policies where necessary. The following policy, which will lead into the topic of

software, is mentioned because of the unique approach it displays:

> The CSC (IC) does not have the authority to dictate which tools to use. To provide thorough support, however, the CSC (IC) must limit its tool set to a manageable size. Therefore, the CSC (IC) has a simple policy: if clients use the tools recommended by the CSC (IC), the door is always open, and the CSC (IC) will provide complete and comprehensive service. If clients use brand X of their own choosing, the CSC (IC) will provide only minimum service and then only after meeting the needs of its regular clients. This policy, applicable to both hardware and software, has been quite successful. [Ref. 128: pp. 138-140]

G. SOFTWARE

Choosing the right software can mean the difference between success and failure for an IC. Allowing end users to choose may result in the use of bundled software that came with the user's personal computer regardless of how good or how appropriate the software may be [Ref. 129: p. 43]. Even worse, the end users may be using each other's software illegally. John Seymour writes the following on this topic:

> A recent magazine article indicated that there are 150,000 registered copies of a leading database package in use and at least that many in use that are not registered. I'd bet the estimate of unregistered copies is very conservative. On a corporate scale this is grand larceny. [Ref. 130: p. 42]

The software developers are starting to pursue flagrant corporate abusers and taking them to court. Most corporations can afford the resulting fines but can ill afford the corporate embarrassment in the public sector. One firm,

Pacific Gas and Electric Company of San Francisco, solves the software piracy (illegal copying) problem with what has been termed a software site license as described in the following:

> We don't buy a copy of the package, we buy the right to use it. In exchange, we make sure our users will not call the vendor; we take over the support function....so far the vendors have been amenable to a single, up-front payment, along with specified payments for upgrades. "We do not pay per copy royalties," Buckholtz said....PG&E also pays for the right to reproduce manuals for the software. [Ref. 131: pp. 95, 100]

Corporations that are interested in controlling software piracy can follow the five steps suggested by G. Gervaise Davis III and paraphrased as follows [Ref. 132: p. 82]:

1. Create a written policy.
2. Communicate that policy.
3. Look around the company for violations.
4. Take action if piracy occurs.
5. Work with software developers (e.g. site licenses).

It is helpful to put software costs in perspective by comparing mainframe software to microcomputer software. A simple comparison is provided below:

> An obvious difference between mainframe and micro software is cost. Many mainframe packages sell for about $80,000 to $120,000. Most micro packages, by contrast, cost between $30 and $1,000. The individual price tag, however, may be deceiving. MIS executives usually purchase only a few copies of a mainframe package, but micro software is often purchased in volume. If there are 300 pcs in your organization and you decide that each one should have a copy of a selected $300 package--bingo! You've just spent $90,000. [Ref. 133: p. 74]

The last software detail to be discussed is integrated software. "Integrated software refers to software that meets two minimal conditions: it offers two or more major applications and allows information to be transferred between these applications with a minimum of effort--perhaps five or 10 keystrokes and in one or two minutes." [Ref. 134: p. 59] The benefits of integrated software are paraphrased in the following list [Ref. 135: p. 60]:

1. Requires less learning.
2. Eliminates the need for entering data more than once.
3. Offers three to six major applications at a cost per application far lower than the unit cost of independently purchased software.
4. Moving from one task to another may require only a keystroke of two.

Not everyone wants integrated software. This is a difficult idea for an IC manager to accept. One vendor states: "What we're seeing is a rebellion against integrated packages forced onto people who don't need them." [Ref. 136: p. 20] What some people are finding is that integrated software is more complicated and therefore is more difficult to use. When a simpler package can meet the needs of end users, they do not want to be stuck with the more difficult package.

H. MANAGING AND CONTROLLING

Many items can fit under the managing and controlling category. One very controversial topic in this area is data

access. The logic of those in favor of direct access is amply explained in the next quotation:

> "The only way that information centers, and personal computers tied to information centers, can reach their true potential is by way of easy access to the corporate database," we were told. "And this means the database itself, not an extract version of it." An extract version may not be up-to-date, or may not have the data that a particular user urgently needs, they said. [Ref. 137: p. 5]

There is, however, a more popular approach, which extols the virtues of extract files or databases. The following are examples of some of these virtues:

> When an extract of the production file is taken, data values can be put in a standard format, obsolete fields can be stripped off, control totals can be checked to ensure accuracy and various computations can be performed as requested by the user. [Ref. 138: p. 56]

Two ways that extract files and databases are handled are indicated in the following two statements:

> (John) Nylen (IC supervisor at Signode Industries) protects corporate data by not allowing any of the end users access to the production files during the first shift processing. Anyone who does development work accesses extracted versions of those files. If they wish to run against the full production file, they submit the job and it runs in batch at night. "We more or less have next day reporting," he explains. "That's served our purposes well, however, because people previously were used to three to six months." [Ref. 139: p. 27]

> Users (at the Brazilian subsidiary of the Chase Manhattan Bank, Banco Lar) cannot access production data without first filing a request with the information support center (IC). The support center (IC) staff defines the fields that are needed from the central data base and copies them to a disk that is accessible from the user's virtual machines. [Ref. 140: p. 29]

Another area of managing and controlling is the concern for what the end users are doing with this technology.

Three unusual aspects dealing with computers as status symbols, the problem of "technostress", and technology infatuation are explained well in the following quotations:

> ...computers and word processors have become status symbols to everyone from secretaries to engineers and from analysts to executives. The status has been refined beyond the Cadillac and the Mercedes. There is anxiety on the part of those who don't have them yet, made worse by the owners who emphasize how easy they are to master. The easier everyone says they are, the easier it will be to look stupid. [Ref. 141: p. 34]

> Technostress...is defined as the inability to adapt to computers. (Craig) Brod (author of a book on technostress) identified two forms of the phenomenon. The first is the feeling of being overwhelmed by the machines and is not confined to the working level, but extends all the way into the executive offices. The second results in people becoming machine-like, in that they overidentify with the computers and lose the interpersonal skills that enable them to deal effectively with people. [Ref. 142: p. 54]

> User department managers must monitor whether users are using information center tools as their daily work rather than as a useful augmentation. "Users become so engrossed in the process, and how much fun it is, that they are constantly doing gee-whiz things," confirms one information center manager, "and the grunt work doesn't get done any more." If that happens, the information center can consult with the user's department manager to see if the applications can be simplified or eliminated. [Ref. 143: p. 26]

Microcomputers have their strengths and weaknesses when compared to other mediums for accomplishing a task. One weakness to be guarded against and which gradually occurs is demonstrated in this example:

> The micro also has bad side effects. It turns each person into a combination computer operator, data entry clerk, and programmer. As one chief financial officer said, "I hired this person as a $75,000-a-year financial analyst, and the micro turned her into a $25,000-a-year programmer." [Ref. 144: p. 98]

IC managers have some problems, also. The full brunt of managing the proliferation of microcomputers does not necessarily have to rest on the shoulders of the IC manager. Marty Maffeo, IC manager for Polaroid Corporation, supports this concept with the next statement:

> Unlike many Fortune 1000 companies, Polaroid's PC strategy is implemented through a committee of users. And, despite the fact that government by committee has often been called the perfect way to get nothing done, Polaroid's Marty Maffeo said it is the ideal system for his company. [Ref. 145: p. 60]

There are many administrative tasks that impact on the IC either in staff time or in other resource utilization. Tasks, such as publishing a newsletter, handling supplies, maintaining libraries, and organizing users groups, quickly expand to consume more staff resources than allocated. The two IC managers, Marie Swanson and Ann Staton, at First National Bank of Minneapolis, agree that this is the case in the following:

> A big surprise was the amount of "administrivia" involved with running their "business within a business." Says Swanson, "Nobody told us how much time it takes to do the class scheduling, promotion, billing, publicity or any of the day-to-day activities that have to be done, but that interfere with the actual work of the information center." [Ref. 146: p. 49]

John Seymour writes about the administration of software:

> The administration of purchased software, especially in the volumes at which it is being purchased, is a significant task. The packages need to be registered by serial number with the vendor. Updates and new versions need to be given serious consideration before distribution is made. Add-on training or regular news bulletins advising users must be made available. [Ref. 147: p. 40]

Exxon Corporation performs an administrative task that helps ease the tension between the applications development staff and the IC through the use of a log. The ensuing statement provides a more detailed account of how this log is used:

> Creating a log of CSC (IC) contacts with clients, which included a brief description of the meeting and any actions taken, was central to improving communication between the CSC (IC) and other departments. CSC (IC) members were free to handle clients' problems directly if the solution was clearly suitable for end-user computing. All contacts, however, were to be logged, and appropriate applications development staff was to be notified immediately if a problem could be best solved by them. The log was distributed monthly to the applications development group and to other interested parties so they could follow up on any CSC (IC) activities deemed appropriate. [Ref. 148: p. 142]

To conclude the topic of managing and controlling, two items connected to financial considerations of an IC are presented as follows:

> Among (Ray) Youstra's (from IBM) suggested techniques for tracking information center performance is an on-line questionnaire, which he said is easy for users to answer and can be directed to a selected subset of users. He recommended that information center management and end users adopt a services agreement, detailing hours of service, expected response times and user responsibilities. "Any system can be built to give you subsecond response time--all it takes is money," Youstra said. [Ref. 149: p. 22]

> In successful information centers, financial considerations receive full attention and support. Financial matters become crucial when considering that in most cases, organizations underestimate start up costs by as much as 60 percent and recurring costs by as much as 40 percent. [Ref. 150: p. 36]

I. OPPORTUNITIES

The topic of opportunities requires examination of the latest technologies and it also requires an imaginative look at productivity. The concept of the IC is based on enhancing end user productivity. The scope of IC responsibility seems to be broadening to include office automation. The IC is a logical place to provide centralized control of basically decentralized functions and, therefore, is as good a place to assign office automation responsibilities as anywhere else. The opportunity for productivity is great. "Over 50% of employed Americans are office workers in clerical, management, professional or semiprofessional positions." [Ref. 151: p. 18] But before the IC starts to improve productivity by using technology, it should ensure that other means have been reviewed. The following facts explain what this means:

> Proper lighting and office design can increase office productivity up to 30%, according to Charles Smith, president, National Assn. of Accountants. A well-administered personnel policy involving motivation and incentives can add 20%. [Ref. 152: p. 18]

The need for new technology is evidenced by the pressure for the IC to provide electronic and voice mail systems is steadily growing. "Telephone tag" is the process of two people trying to get a hold of the other, and the other person is always unavailable. People are becoming more impatient with the inefficiency of the present telephone system and want a solution. As one author writes:

> ...about 52 percent of all telephone calls in the office are uncompleted on the first try. The game of "telephone tag" is a most frustrating waste of time. [Ref. 153: p. 139]

These new solutions may not stand up to their promises. Evelyn Wilk, Senior Manager of Arthur Anderson and Company claims:

> "Right now you can tie 100 personal computers together and you don't really have anything except physical connects and shared files," said Wilk. "All of the pieces are there but you don't have a system. You don't really have a file management program or transparent capabilities. [Ref. 154: p. 20]

Another deception may be in the area of response times. Compare the following two quotations:

> ...there is no agreement as to what constitutes acceptable response time; it depends on how long one is willing to sit at a terminal and wait for the computer to reply after a request is entered. A lot of factors influence response time, including the hardware, software, and the nature of the inquiry. For the most part, response times in the two-second range are great, three to six seconds are tolerable, and more than eight or nine seconds irritating, depending on the application. [Ref. 155: p. 108]

> Computer scientist Ben Shneiderman, for one thinks quick response times can lower productivity in many cases....To back his claim that slower can be better, Shneiderman cited studies that found user error rates can jump when response times are quickened, particularly involving complex tasks. He cited a Bell Laboratories study that turned up an optimum response time of 12 seconds for a specific application. [Ref. 156: p. 14]

There is potential for poor productivity in one often used segment of end user computing. That segment is generation of graphics. If not controlled properly, graphics can be costly and time consuming. Two examples of this phenomenon are:

> But graphics are also easy to misuse. There are numerous instances where senior-level end users spent a half hour or more in front of a crt to get one graph just right or tried to use a two pen plotter to create several transparencies at one sitting. These situations are a waste of time and manpower because an administrative group now exists to create such charts. The CSC (IC) is now searching for more user-friendly graphics tools while instructing clients on using the current ones more effectively. [Ref. 157: p. 142]

> A bank vice president creates slides, almost instantaneously, for 30 cents each. The old, traditional approach took several days and cost $35 per slide. She now uses slides for routine presentations rather than only on special occasions. [Ref. 158: p. 246]

Beth A. Benson, a financial graphics programmer at Johnson and Johnson, has captured the topic of graphics use in the following quotation:

> We had an established need for some level of graphics because management was overloaded with paper and computer-generated reports; it needed to see less detail and more trends. Some of our users were creating charts manually on a routine basis, while presentation graphics were contracted out to a printer....Computer graphics applications are increasing constantly. As companies grow and the amount of data increases, the need for simplification and exception reporting increases. [Ref. 159: pp. 47-48]

The last opportunity to be examined is a particular system installed at the University of Texas Law School. It is described as follows:

> The Kurzwell scanning and processing system is different from other OCR (optical character recognition) scanning systems because it can scan and recognize almost any font in typewritten or typeset materials in sizes ranging from small six-point type to relatively large 24-point type.... In this way, rekeying is eliminated, saving both time and typographical errors. [Ref. 160: pp. 128-129]

VII. REVIEW PHASE

A. PURPOSE OF THE REVIEW PHASE

The purpose of the review phase is to evaluate the effectiveness of the SDLC and the management techniques applied, and to determine whether projected benefits have been utilized and whether enhancements are desirable and justifiable.

B. DEVELOPMENT RECAPITULATION

The objective of this activity is twofold. The first requirement is to determine the appropriateness of the SDLC methodology to the problem of end user computing. The second requirement is to evaluate the degree of success of the project development team in the utilization of the SDLC methodology and the documentation of mistakes for future reference.

Determination of the appropriateness can be difficult. As one author states:

> Analytical and modeling techniques that were inadequately understood and improperly applied by planning professionals will soon be applied even more improperly by staffs throughout corporations. Few practitioners understand the limitations of business analysis and modeling. Now, anyone can have at desktop enormous computer power. This distributed computer power combined with the naivete bodes national economic mayhem. [Ref. 161: p. 9]

The prejudice of ignorance is difficult to overcome. In addition to ignorance, there is another prejudice which

should be avoided. This prejudice is loyalty to a particular methodology. It is like the child who tries to force the square peg into the round hole; it does not work very well. John Seymour adds some commentary to this idea:

> And we all have our religions when it comes to methodologies, implementation techniques, brand names, and standards for judging who's good and who isn't. And most methodologies work under the right circumstances, and fail under the wrong ones. [Ref. 162: pp. 15-16]

The second requirement, to determine how well the SDLC study methodology was utilized, can be based on a brain storming session at the end of the study and an examination of the documentation that was accumulated throughout the project. Complaints from team members, the length of actual development time, and the amount of duplicated effort are all indicators of the team's performance.

C. POST IMPLEMENTATION REVIEW

The purpose of this review is to evaluate how well the system has performed in meeting original expectations and projections for improvement, and to identify any maintenance projects that should be undertaken to improve or enhance the implemented system. In other words, it is a review of how well the IC is doing, and what else can be done.

This review should be formal in nature and should be conducted at appropriate intervals to be decided at the end of the implementation phase. It should include an examination of productivity measurements, a review of any audits

conducted, a review of the use of the latest technology, and an evaluation of a survey of the end users. The business objectives should be reconsidered in case there has been a change, and also to reinforce the basic underlying premise of the purpose of the IC. Lastly, there should be some provision to conduct partial reviews whenever the situation changes or the circumstances warrant.

VIII. CONCLUSION

A. GENERAL OBSERVATIONS

The IC seems to fill a gap in the traditional management structure of most organizations. The traditional hierarchical organization lacks the ability to control and maximize the productive use of end user computing. It would be easier if these organizations were organized around functional capabilities vice the normal departmental structures or product lines. Most organizations find that the functions provided by the IC help to cross rigid departmental boundaries but have potential to cause problems if not properly controlled. As one author writes:

> Information is such a critical resource that some companies find its care can no longer fall under several different, and sometimes uncoordinated, domains. These businesses are setting up information centers that not only help users, but also draw all aspects of information processing under one umbrella. [Ref. 163: p. 75]

Even the manner in which an IC is implemented can affect the productivity of one department over another and can make a major impact on the corporate strategy. Some control, however, is better than none, and implementing an IC is almost always more productive than not implementing an IC. Vaughn Merlyn supports this idea when he writes:

> The vast majority of Information Centers are implemented below "par", and it seems that there are two "laws of the Information Center" that are inescapable. The first law is, "It is virtually impossible to implement an

Information Center so badly that it will not experience success early in its life." The second law states, "It is virtually impossible to implement an Information Center so well that it will not experience significant problems later in its life." [Ref. 164: p. 29]

End user computing expertise is often lacking. General managers find not only the technology difficult to master, but the unique management requirements are equally burdensome. This is partially because the IC concept is new. Likewise, the amount of resources required, to remain current in the fast moving field of computers, is prohibitively uneconomical for most departments and requires the resources and coordination of a larger body, usually the corporation itself. Mostly, because of these reasons, ICs are gaining popularity and, in some cases, are approaching the status of being a necessity:

> IBM claims that 42 percent of its largest computer users have these centers (ICs), and a recent survey of 32 major companies found that two-thirds expect to support two or more information centers by 1985. [Ref. 165: p. 30]

> It is estimated that some 40 percent of mainframe installations in North America have Information Centers--whether or not under the name--in place. The majority of the balance are planning to establish such centers. The corporate use of personal computers is also spreading. [Ref. 166: p. 12]

Management is also finding that end users can not be stopped in their fervor for end user computing. End users, left to their own devices, often misuse the technology because of lack of skills or knowledge, poor application of resources, or infatuation with the technology. This results in suboptimal productivity and poor return on investment.

Control, often in a form similar to the IC, is usually required.

In a survey conducted in 1982 and updated in 1984, 96 northeast Ohio organizations answered questions about personal computing. These businesses showed gross revenues ranging from $50 million to over $2 million. Figure 8 shows the results of this survey. Because this survey was not scientifically generated or analyzed it can not be considered a true trend analysis nor can it be considered statistically significant. It is, however, better than intuition alone. The benefit of this survey is that it compares personal computing information from the same organizations over a two year period. This provides general trend information. Unfortunately, the limited geography of the sample and absence of scientific process limit the effectiveness of its results. [Ref. 167: p. 128]

APPARENT TRENDS IN PERSONAL COMPUTING
BASED ON 96 ORGANIZATIONS SURVEYED (1982-1984)

	1982	1984
Companies with business personal computing......	13	68
In the selection and acquisition of personal computers, the MIS department has:		
control over the selection process........	2	52
advisory capacity only....................	6	13
no input..................................	3	3
Formal user training program....................	0	26
Formal help desk................................	0	33
Company planning for personal computing.........	0	8
Local area networking...........................	0	12
User groups.....................................	2	41
Personal computing library......................	0	29
Equipment demonstration facilities..............	2	38

Figure 8. Trends in Personal Computing

Based on the degree of success experienced by most ICs, even those facing great internal resistance, it appears that any organization that makes a bonafide effort at establishing an IC can be successful. Nevertheless, some organizations, unaware of how desperately they are in need of an IC, are reluctant to establish one. As one author states:

> Many organizations are spending more on user-purchased hardware, software and services than they realize. One large manufacturing company discovered that end-user purchases accounted for 40% of the total dollars spent on hardware, software and services. In some instances these dollars were well spent; in others, they were redundant to what was already available. The Information Center should adopt a strategy that fits smoothly into the way user departments are currently operating. Users should not be forced to convert to the Information Center service if it will impair their productivity or cost them more. [Ref. 168: p. 32]

These organizations are becoming aware of the need to control information and information technology. One influence on this awareness is the Foreign Corrupt Practices Act (FCPA) of 1977 which requires managers to implement internal controls on corporate assets. Information, data, and computing resources are being considered assets under the FCPA and therefore should be controlled. Kevin Francella shows, in a more universal context, the impact of information as an asset:

> As the United States suffers the spasms of moving from an industrial society to an information society, US business is beginning to regard information as a tangible asset. Information processing activities account for about 70 percent of the US employment, and also account for more than 46 percent of the Gross National Product, according to figures from the National Science Foundation. [Ref. 169: p. 15]

B. APPLICATION OF THE METHODOLOGY

The SDLC methodology is a viable way to evaluate and implement an IC. This thesis has given general guidance as to how to apply a slightly modified version of the SDLC as proposed by Michael J. Powers, David R. Adams, and Harlan D. Mills [Ref. 170]. The major SDLC modifications were those that were required to better adapt the SDLC to the IC situation. This methodology can be used as extensively or as sparingly as the situation warrants. It also has the flexibility to complement other methodologies and can be used as imaginatively as necessary. For the manager who is suddenly faced with the task of establishing an IC and who has no idea as to how to proceed, this thesis can be of significant value. For the manager with experience with the SDLC methodology, it should even be easier to benefit from this thesis.

There are other methodologies that can be used to establish an IC. One method, as proposed by Jean L. Chastain, is to not use any methodology at all:

> If you want to set up an information center and you don't have a lot of money to do it, the best plan may be not to plan at all. "I'm challenging you to try it even without a budget, without proper support," said Jean L. Chastain, information center project manager at Economics Laboratory, Inc., a manufacturing company based in St. Paul, Minn. "It doesn't take a lot of money. A successful outcome is determined more by attitude than by budget," she told a recent conference here. [Ref. 171: p. 22]

It would seem that this only works where the IC is small and not comprehensive. Another method that is highly successful

is to utilize familiar methodologies. Wetherbe covers this topic well:

> Many organizations develop their own formal systems development methodology. Research indicates that these methodologies seem to work as well as the formalized development methodologies. The important thing is that a comprehensive template or checklist must be used to manage the process. One criticism of systems development methodologies is that they are often so comprehensive and require so much attention to details and procedures that they can get in the way of progress particularly for short, simple projects. Accordingly, the steps and procedures within a systems development methodology should only be considered as a checklist, and not every step or procedure should necessarily be executed for each development project. In other words, some discretion should be used in evaluating which items on a checklist are appropriate for a particular project. [Ref. 172: p. 129]

An advantage of the systems approach is the attainment of synergy. "This means, simply, that when a system is functioning as it should, it produces results with a value greater than the total value produced by its separate individual parts." [Ref. 173: p. 5] Another advantage of this methodology is explained in the following:

> The value of this hierarchical approach lies in a perspective that forces problem solvers and managers to deal with problems at different levels of abstraction. That is, goals and objectives are formulated with increasing levels of detail from top to the bottom of the hierarchy. At the top of the organization, goals are described functionally, in terms of the overall mission. At the bottom level, the objectives are clearly operationalized in terms of specific actions that must be taken or specific results that must occur. [Ref. 174: p. 18]

As discussed previously, the feasibility study is usually a large part of the SDLC. Nevertheless, it is not a mandatory requirement. There are several good reasons for performing a feasibility study. One is that formal

justifications for all projects may be required by the organization. Another is to help identify organizational priorities. A third reason is to help identify objectives and develop a standard against which to measure success. On the other hand, there are also good arguments against a feasibility study. Since the IC can be considered a research and development effort, it may require little or no justification. Another reason may be that the IC is intuitively justifiable or the benefits are so blatantly abundant that a feasibility study is, for all practical purposes, a waste of resources. A final reason may be because the IC is designed solely to solve a management problem regardless of the return on investment. Again, the circumstances dictate the action to be taken but more often than not, some sort of justification is required.

C. MILITARY AND FEDERAL APPLICATIONS

Although this thesis has concentrated on ICs in the private sector, this does not have to exclude the military or federal agencies. The requirement to eliminate fraud waste and abuse in the federal government is a good reason to implement an IC. An article from <u>Government Computer News</u> [Ref. 175: p. 26] lists two military ICs and fifteen other federal ICs that have been implemented. This shows that the IC concept will work in federal agencies as well as the private sector.

This does not mean, however, that implementing an IC is any easier in the government than it is in the private sector. The government, because of its numerous regulations and bureaucratic inflexibility, may cause the application of controls and excessive justification during the first or second stage of technological assimilation. This could nullify the benefits to be gained from an IC. Even worse, overregulation could cause the IC to fail before it had a chance to prove its value. It seems, however, that those agencies that have tried to establish ICs have been successful. Therefore, other federal agencies can learn not only from this group of successful implementors, but they can also learn from the ICs implemented in the private sector. Therefore, this thesis can be of value to the federal manager.

D. EPILOGUE

There is general agreement that a properly implemented IC is a "win-win situation for users and DP (data processing department) alike." [Ref. 176: p. 25] Although managers are still asking what an IC can do for their organization, these same managers "are beginning to realize that the benefits of information access and analytical capability outweigh the time taken to handle the mechanics of the process." [Ref. 177: p. 33] Appendix A is a combination of two lists of IC benefits: one list is from the FTP

survey [Ref. 178: p. 36] and the other list is from from The Crwth Information Center Survey [Ref. 179: p. 17]. These lists are intended as examples of reasons for an organization to establish an IC. These two lists should not be compared against each other because the sample sizes, the questions, and the responses were different for each study. The only comparison intended, is to provide the opportunity to note benefits that show up on both lists and which can therefore be considered to more accurately reflect the more important, or at least the most notable, benefits.

Because benefits of ICs have been identified, it seems appropriate to identify the obstacles that were listed by the same two previous surveys, the FTP survey [Ref. 180: p. 37] and The Crwth Information Center Survey [Ref. 181: p. 18]. The list of obstacles may help the developer of an IC as much, if not more, than the list of benefits. The same comparison criteria applies to obstacles as applied to benefits.

Prioritizing can be a problem for managers. IC priorities are sometimes difficult to verbalize, let alone rank. Therefore, Appendix C [Ref. 182: p. 128] has been provided to show the major personal computing problems listed in order of importance as ranked by 52 MIS managers attending a seminar on IC management. This list can also be used by the IC developer as a checklist.

The future of ICs seems secure for the moment. They have achieved momentum and are propagating rather rapidly. Some people are saying that ICs are, at best, only temporary institutions as stated in the following:

> An information center is not a permanent institution....An IC is a limited, short-term concept that is a stepping-stone on the road to what one IC specialist, Bernard Plagman, calls "end-user computing....We won't need the information center when natural language processing becomes the front end of computers, and when the so-called 'expert systems' become business-oriented instead of DP-oriented as they are today." [Ref. 183: p. 45]

This view of the future of ICs ignores the management gap that the IC concept fills. Unless there is a drastic restructuring of organizations, most organizations will still need some form of centralized control and expertise for end user computing. The only lingering question is whether ultimately the IC tools will eventually be treated as casually as the telephone is today, or whether there will always be a need for the IC. It is this author's opinion that the IC is more permanent than it is temporary.

APPENDIX A

BENEFITS OF INFORMATION CENTERS

FTP SURVEY (1983)

1. Increased End-User Computer Understanding, including IS Resource Utilization, Procedures and Problems
2. Improved End-User/IS Department Relations
3. More Effective Utilization of IS People Resources
4. Improved End-User Productivity
5. End-User More Self-Sufficient, Independent
6. Improved Decision-Making Support
7. Ease of Access to Information
8. Reduction in Applications Backlog
9. Corporate Management Sees IS as More Responsive
10. Other Benefits
    - Overall Cost Reduction
    - Better Definition of Business Needs
    - Reduction of Outside Timesharing Costs
    - Increased Creative Use of Computing
    - Better Resource Management
    - Developing Training for the Department
    - Automation of Considerable Clerical Tasks
    - "Flexible" Applications

CRWTH SURVEY (1984)

1. Increased Job Productivity
2. Better Use of Information Resources
3. Improved Computer Literacy
4. Improved DP/End User Relations
5. Reduction of DP Backlog

APPENDIX B

OBSTACLES OF INFORMATION CENTERS

FTP SURVEY (1983)

1. Inadequate IS Resources to Support IC
2. Resistance within IS, Territorial Conflicts
3. Software Limitations
4. Providing Access to Pertinent Data Fast Enough
5. Lack of End-User Commitment to Concept
6. End-User Reluctance to Train, Do the Work
7. Lack of Business Reason, Cost-Justification
8. Defining Criteria for Applications - IC vs. Regular Development
9. Lack of Adequate Vendor Support
10. Lack of Resources to Train End-Users
11. Budget Constraints
12. Management's Attitude
13. Other:
    Data Security
    Selection of Initial End-Users and Timeframe
    Restrictions on Choice of Hardware and Software
    Poor Implementation
    Overlay High End-User Expectations
    Poor Follow-Through by IC Staff
    Too Late, Generation Language Already Implemented
    Growth in Utilization
    Lack of Charge-Back Methodology
    Lack of Adequate Standards

CRWTH SURVEY (1984)

1. Shortage of Trainers and Product Consultants
2. Lack of End User Awareness
3. System Resource Shortage
4. DP Resistance
5. Management Resistance
6. Lack of Chargeback

APPENDIX C

MAJOR PERSONAL COMPUTING PROBLEMS

1. Lack of a company plan for personal computing.
2. Lack of user education regarding a companywide and a long-term perspective about personal computing.
3. Unnecessarily high costs to the company due to users learning by trial and error about lack of compatibility with other micros.
4. Poor maintainability of user-developed systems.
5. General lack of communication between the MIS department and users.
6. Overwhelming growth of user requests for assistance from the MIS department.
7. Unnecessarily high costs to the company due to users learning by trial and error how to use available software packages.
8. Contamination of corporate data on the company's mainframe.
9. Mismatch of user applications to other possible user computing alternatives, such as mainframe packages or the traditional approach for systems development.
10. MIS department has image problem with personal computing users.
11. Lack of equivalent or better (more user-friendly, etc.) mainframe software packages to compete successfully with microcomputer software packages.
12. Lack of adequate training on products, computer concepts, etc.
13. Unnecessarily high costs to the company due to users "reinventing the wheel" in systems development.
14. Lack of user knowledge or concern about microcomputer data integrity measures such as a file backup.

15. Lack of integration of micro/mainframe data exchange and control.

16. Inability of mainframe computing to compete with personal computing in terms of cost/benefit in certain areas.

17. Lack of control over user computing resources utilization in user departments by the user department management.

18. Lack of adequate support from hardware vendors.

19. Lack of adequate support from software vendors.

20. Lack of control over user computing resources utilization in user departments by the MIS department.

21. Personal computing is further straining MIS department relations with users.

22. Lack of centralized management over corporate data resources to support user personal computing.

23. Lack of appropriate staffing to identify and service potential information center customers.

24. Lack of user concern about personal computing equipment security.

25. Information overloading due to too many vendors and products in a given area: micros, software packages, local area networks, etc.

26. Lack of user interest in using personal computers.

27. Lack of integration in MIS management of personal computing and mainframe user computing.

28. Unnecessarily high costs to the company due to users learning by trial and error about lack of compatibility with other micros.

29. Unnecessarily high costs to the company due to users learning by trial and error how to negotiate with vendors.

30. Measuring the level of user computing activity.

31. Unnecessarily high costs to the company due to users learning by trial and error about lack of compatibility with microcomputer peripherals.

32. Malicious or unauthorized user behavior regarding company property.

NOTE: The above listing represents the concerns of 52 MIS managers at a seminar on information center management. The list is rank ordered based on the average level of importance from most important (1) to least important (32).

LIST OF REFERENCES

1. "IBM's Information Center: Where It All Began," Computerworld, v. XVII/XVIII, 26 December 1983/02 January 1984.

2. Hammond, L. W., "Management Considerations for an Information Center," IBM Systems Journal, v. 21, 1982.

3. O'Mara, Janet, "Building an Information Center That Works," ICP Data Processing Management, Autumn 1984.

4. Johnson, Richard T., "The Infocenter Experience," Datamation, January 1984.

5. Davis, Richard S., "Info Centers Springing Up to Teach," Information Systems News, 6 August 1984.

6. "Roundtable (Micro Mission)," Computerworld Extra!, v. 17, 30 November 1983.

7. "Health Firm's Ills Lead to Info Center Cure," Computerworld, 26 September 1983.

8. Cowan, William M., "The 'I Center'--An Office Resource Comes of Age," Office Administration and Automation, February 1984.

9. Harrar, George, "Information Centers: The Users' Report," Computerworld, v. XVII/XVIII, 26 December 1983/02 January 1984.

10. Murray, John P., "How an Information Center Improved Productivity," Management Accounting, March 1984.

11. Hearn, Steve, "A New Challenge: The Information Center," Journal of Information Systems Management, v. 1, Winter 1984.

12. Cahier, Jean-Pierre, "Ironing Out Info Center Kinks," Computerworld, 12 March 1984.

13. Kull, David, "Information Centers: Power to the People," Computer Decisions, June 1984.

14. Gillin, Paul, "Anheuser-Busch Says No to Micros, Yes to Info Center," Computerworld, 28 May 1984.

15. McFarlan, F. Warren and McKenney, James L., *Corporate Information Systems Management*, Richard D. Irwin, Inc., 1983.

16. Ibid.

17. Wetherbe, James C., *Systems Analysis and Design*, West Publishing Company, 1984.

18. Powers, Michael J., Adams, David R., and Mills, Harlan D., *Computer Information Systems Development: Analysis and Design*, South-Western Publishing, 1984.

19. Ibid.

20. Ibid.

21. Ibid.

22. Wetherbe, James C., *Systems Analysis and Design*, West Publishing Company, 1984.

23. Ibid.

24. Ibid.

25. Ibid.

26. Samuelson, Kjell, Borko, Harold, and Amey, G. X., *Information Systems and Networks*, North-Holland Publishing Company, 1977.

27. Wetherbe, James C., *Systems Analysis and Design*, West Publishing Company, 1984.

28. Samuelson, Kjell, Borko, Harold, and Amey, G. X., *Information Systems and Networks*, North-Holland Publishing Company, 1977.

29. Powers, Michael J., Adams, David R., and Mills, Harlan D., *Computer Information Systems Development: Analysis and Design*, South-Western Publishing, 1984.

30. Kull, David, "Information Centers: Power to the People," *Computer Decisions*, June 1984.

31. "Users Groups Sprouting Up," *Computerworld*, 19 September 1983.

32. Morris, Mike, "Info Centers Mushrooming," *Government Computer News*, 17 September 1984.

33. "User Groups," IBM Innovation, November 1984.

34. "Future Effects of End User Computing," EDP Analyzer, v. 21, November 1983.

35. McFarlan, F. Warren, "Information Technology Changes The Way You Compete," Harvard Business Review, May-June 1984.

36. Porter, Michael E., Competitive Strategy, The Free Press, 1980.

37. Trimmer, Dan, "Information Centre: All That Glitters...," The IBM System User, November 1983.

38. Alloway, Robert M. and Quillard, Judith A., "User Managers' Systems Needs," Management Information Systems Quarterly, June 1983.

39. Powers, Michael J., Adams, David R., and Mills, Harlan D., Computer Information Systems Development: Analysis and Design, South-Western Publishing, 1984.

40. Ibid.

41. Wetherbe, James C., Systems Analysis and Design, West Publishing Company, 1984.

42. Powers, Michael J., Adams, David R., and Mills, Harlan D., Computer Information Systems Development: Analysis and Design, South-Western Publishing, 1984.

43. "Future Effects of End User Computing," EDP Analyzer, v. 21, November 1983.

44. Nolan, Richard L. and Gibson, Cyrus, F., "Managing the Four Stages of EDP Growth," Harvard Business Review, January-February 1974.

45. McKenney, James L. and McFarlan, F. Warren, "The Information Archipelago--Maps and Bridges," Harvard Business Review, September/October 1982.

46. McFarlan, F. Warren, McKenney, James L., and Pyburn, Philip, "The Information Archipelago--Plotting a Course," Harvard Business Review, January/February 1983.

47. McFarlan, F. Warren and McKenney, James L., Corporate Information Systems Management, Richard D. Irwin, 1983.

48. "Future Effects of End User Computing," *EDP Analyzer*, v. 21, November 1983.

49. Johnson, James J., "Enterprise Analysis," *Datamation*, 15 December 1984.

50. Powers, Michael J., Adams, David R., and Mills, Harlan D., *Computer Information Systems Development: Analysis and Design*, South-Western Publishing, 1984.

51. Meyer, N. Dean, "Info Centers: OA Retail Shops," *Today's Office*, October 1984.

52. O'Mara, Janet, "Building an Information Center That Works," *ICP Data Processing Management*, Autumn 1984.

53. Harrar, George, "Information Centers: The Users' Report," *Computerworld*, v. XVII/XVIII, 26 December 1983/02 January 1984.

54. Hearn, Steve, "A New Challenge: The Information Center," *Journal of Information Systems Management*, v. 1, Winter 1984.

55. O'Mara, Janet, "The Information Center: The Nucleus of Productivity," *ICP Business Software Review*, August/September 1984.

56. "Cutting Through The Hidden Costs Of Computing," *Personal Computing*, October 1984.

57. Ibid.

58. Ibid.

59. Gabel, David, "Keeping Corporate Computers Personal," *Personal Computing*, March 1984.

60. "Future Effects of End User Computing," *EDP Analyzer*, v. 21, November 1983.

61. Seymour, John, *Coping With Computer Egos*, American Management Associations, 1984.

62. "How Does Info Center Fit In Firm's Reporting Structure?," *Computerworld*, 7 February 1983.

63. Johnson, Richard T., "The Infocenter Experience," *Datamation*, January 1984.

64. Ibid.

65. Couger, J. Daniel, "Blue Skies Ahead," Datamation, 15 December 1984.

66. McCartney, Laton, "The New Info Centers," Datamation, July 1983.

67. Murray, John P., "Develop Your Information Center in Phases," Computerworld, 27 February 1984.

68. Gillin, Paul, "Successful Information Center Starts Small, Thinks Big," Computerworld, 12 November 1984.

69. Hearn, Steve, "A New Challenge: The Information Center," Journal of Information Systems Management, v. 1, Winter 1984.

70. Seidman, Marsha, "Coming of Age: The Information Center Grows Up," Data Training, January 1984.

71. Burns, Peggy, "Seizing the Information Center Opportunity," Infosystems, August 1984.

72. Desmond, John, "Speaker Says Info Centers Must Prove Their Effectiveness," Computerworld, 10 September 1984.

73. Bracy, Marilyn, "Info Center Success 'Centers' Around the DP Manager", Data Management, February 1984.

74. "Bank's IC Serves Growing List of Users," Software News, September 1984.

75. Bartimo, Jim, "What's Hot! What's Not!," Computerworld, v. XVII/XVIII, 26 December 1983/02 January 1984.

76. "Awareness Campaign Reaches 2,000 Users," Computerworld, 19 September 1983.

77. Karten, Howard A., "Information Centers: The View From Inside," Systems User, v. 5, April 1984.

78. "DP Managers Pleased with Info Centers," Computerworld, 7 February 1983.

79. Tesch, Robert T., Sr. and Tesch, Debbie B., "Are Management Information Systems the Answer or the Question?," Interface, v. 6, Fall 1984.

80. Kull, David, "Information Centers Help Users Put It All Together," Computer Decisions, February 1983.

81. "Marketing the Information Center", Infosystems, June 1984.

82. "Information Center: Changing Technology Could Effect DP The Way It Did Detroit," Infosystems, October 1984.

83. Richardson, Marilyn J., "Marketing the Information Center", Computerworld, 19 September 1983.

84. Rhodes, Wayne L., Jr., "The Information Center Extends a Helping Hand," Infosystems, January 1983.

85. "How Personal Computers Can Trip up Executives," BusinessWeek, 24 September 1984.

86. Wakin, Edward, "Computer Literacy: An Executive Education," Today's Office, July 1984.

87. Ibid.

88. Roman, David, "Training New Users," Computer Decisions, October 1984.

89. Stang, David J., "Training Micro Users," Government Computer News, 17 September 1984.

90. "Computer-Based Training for End Users," EDP Analyzer, v. 21, October 1983.

91. Stang, David J., "Training Micro Users," Government Computer News, 17 September 1984.

92. D'Attilo, Lauren, "Proper Training for PC Users," Datamation, 15 December 1984.

93. Morris, Mike, "Info Centers Mushrooming," Government Computer News, 17 September 1984.

94. Beeler, Jeffry, "Corporate Use of Computer-based Training Remains Low," Computerworld, 24 September 1984.

95. Ibid.

96. Beeler, Jeffry, "Micro Growth Boosting Market For End-User CBT Tools," Computerworld, 24 September 1984.

97. Brown, Gary DeWard, "Learning the Magic Words: CBT Course Design for End User Training," Data Training, September 1983.

98. Ibid.

99. Ibid.

100. Brown, Gary DeWard, "Data Processing Concepts for End Users," *EDP Analyzer*, December 1983.

101. Zemke, Ron, "The Information Center: Bringing Computing to the Masses," *Training*, v. 21, February 1984.

102. Merlyn, Vaughan, "The IC Top to Bottom," *Systems User*, v. 5, April 1984.

103. Seymour, John, *Coping With Computer Egos*, American Management Associations, 1984.

104. Davis, Richard S., "Info Centers Springing Up to Teach," *Information Systems News*, 6 August 1984.

105. Johnson, Richard T., "The Infocenter Experience," *Datamation*, January 1984.

106. "Fluid-Handling Technology Firm Brings Up On-Line Info Center to Handle Data, Improve Manager's Efficiency," *Computerworld*, 24 September 1984.

107. "A Little Training Can Go a Long Way in Info Centers," *Data Management*, February 1984.

108. Merlyn, Vaughan, "The IC Top to Bottom," *Systems User*, v. 5, April 1984.

109. Jones, Phil, "The Information Centre: A Beacon in the Darkness," *Computing*, 31 May 1984.

110. Johnson, Richard T., "The Infocenter Experience," *Datamation*, January 1984.

111. Gillin, Paul, "Run Info Center as Separate Profit Center, User Urges," *Computerworld*, 18 June 1984.

112. Burns, Peggy, "Seizing the Information Center Opportunity," *Infosystems*, August 1984.

113. Beeler, Jeffry, "Manager Urges Info Centers to Limit Support," *Computerworld*, 12 March 1984.

114. Johnson, Richard T., "The Infocenter Experience," *Datamation*, January 1984.

115. "The Information Center: Essex Group Opens Path to Corporate Data Base," Infosystems, January 1983.

116. Johnson, Richard T., "The Infocenter Experience," Datamation, January 1984.

117. Warner, Edward, "DP Departments Must Support End Users, Speaker Says," Computerworld, 10 September 1984.

118. Merlyn, Vaughan, "The IC Top to Bottom," Systems User, v. 5, April 1984.

119. Brown, Gary D. and Sefton, Donald H., "The Micro VS. the Applications Logjam," Datamation, January 1984.

120. Seymour, John, Coping With Computer Egos, American Management Associations, 1984.

121. Meyer, N. Dean, "Info Centers: OA Retail Shops," Today's Office, October 1984.

122. Fleig, Clare P., "Realtor Dedicated to PC Use," Information Systems News, 10 December 1984.

123. "Remedy for Reluctant Users: Seed Micros," Computer Decisions, June 1984.

124. Fleig, Clare P., "Realtor Dedicated to PC Use," Information Systems News, 10 December 1984.

125. Seymour, John, Coping With Computer Egos, American Management Associations, 1984.

126. Ibid.

127. Welter, Jacques, "Personal Computer Strategies: UTC Curbs Its Pioneering Spirit," Information Systems News, 05 November 1984.

128. Johnson, Richard T., "The Infocenter Experience," Datamation, January 1984.

129. Celko, Joe, "Applying Mainframe Lessons to PC Software," Information Systems News, 1 October 1984.

130. Seymour, John, Coping With Computer Egos, American Management Associations, 1984.

131. Schindler, Paul E., Jr., "Buying Rights to Copy Disk," Information Systems News, 1 October 1984.

132. Davis, G. Gervaise III, "How to Avoid Copyright Suit," Information Systems News, 10 December 1984.

133. Nesbit, Irene S., "Evaluating Micro Software," Datamation, 15 July 1984.

134. Stang, David J., "Integrated Software: What in the World Is It?," Government Computer News, 17 September 1984.

135. Ibid.

136. Emmett, Arielle, "PC User 'Rebelling' Against Integrated Packs," Information Systems News, 24 December 1984.

137. "Coping with End User Computing," EDP Analyzer, v. 22, February 1984.

138. Clarke, Bill, "Dos and Don'ts for Effective Info Center," Computerworld, 25 April 1983.

139. O'Mara, Janet, "Building an Information Center That Works," ICP Data Processing Management, Autumn 1984.

140. Gillin, Paul, "Brazilian Bank Lauded for Its Info Support Center," Computerworld, 4 June 1984.

141. Seymour, John, Coping With Computer Egos, American Management Associations, 1984.

142. Price, Douglas S., "Author Sees 'Technostress'," Government Computer News, July 1984.

143. O'Mara, Janet, "Building an Information Center That Works," ICP Data Processing Management, Autumn 1984.

144. Brown, Gary D. and Sefton, Donald H., "The Micro vs. the Applications Logjam," Datamation, January 1984.

145. Welter, Jacques, "Personal Computer Strategies: Polaroid Tries a Group Shot," Information Systems News, 15 October 1984.

146. Zemke, Ron, "The Information Center: Bringing Computing to the Masses," Training, v. 21, February 1984.

147. Seymour, John, Coping With Computer Egos, American Management Associations, 1984.

148. Johnson, Richard T., "The Infocenter Experience," Datamation, January 1984.

149. Desmond, John, "Speaker says Info Centers Must Prove Their Effectiveness," Computerworld, 10 September 1984.

150. "Paying Attention to Financing Will Save Big Bucks," Data Management, February 1984.

151. "1984 Annual," The Office, January 1984.

152. Ibid.

153. Ross, Charles A., "What's Office Automation All About," Signal, May/June 1982.

154. "Users, DP: Beware Omission on Scenario," Infosystems, October 1984.

155. Lucas, Henry C., Coping with Computers, The Free Press, 1982.

156. "Faster Response Time Not Necessarily Better For Computer User," Infosystems, July 1984.

157. Johnson, Richard T., "The Infocenter Experience," Datamation, January 1984.

158. Krigman, Alan, "The OA Hoax," Datamation, September 1983.

159. Benson, Beth A., "Computer Graphics for Financial Management," Management Accounting, January 1984.

160. "Generating Information Through Automatic Scanning," Infosystems, November 1984.

161. Seadler, Stephen E., "Computer Power Plus Naivete Equals Mayhem," Business Week, 5 November 1984.

162. Seymour, John, Coping With Computer Egos, American Management Associations, 1984.

163. Nofel, Peter J., "The Information Center," Modern Office Technology, v. 29, February 1984.

164. Merlyn, Vaughan, "The IC Top to Bottom," Systems User, v. 5, April 1984.

165. Seymour, John, Coping With Computer Egos, American Management Associations, 1984.

166. Merlyn, Vaughan, "The IC Top to Bottom," Systems User, v. 5, April 1984.

167. Guimaraes, Tor, "The Evolution of the Information Center," Datamation, 15 July 1984.

168. Clarke, William, "It's a Jungle Out There," Computerworld, 23 February 1983.

169. Francella, Kevin, "Information Resource Management: A Brief Overview," Data Management, January 1983.

170. Powers, Michael J., Adams, David R., and Mills, Harlan D., Computer Information Systems Development: Analysis and Design, South-Western Publishing, 1984.

171. Gillin, Paul, "Attitude, Not Budget, Seen Key to Info Center," Computerworld, 18 July 1983.

172. Wetherbe, James C., Systems Analysis and Design, West Publishing Company, 1984.

173. Powers, Michael J., Adams, David R., and Mills, Harlan D., Computer Information Systems Development: Analysis and Design, South-Western Publishing, 1984.

174. Ibid.

175. Morris, Mike, "Info Centers Mushrooming," Government Computer News, 17 September 1984.

176. O'Mara, Janet, "Building an Information Center That Works," ICP Data Processing Management, Autumn 1984.

177. Management Assessment User Driven Technologies Personal Computers, Information Centers, and Fourth Generation Methodologies, FTP Technical Library, 1983.

178. Ibid.

179. Garcia, B., "The Crwth Information Survey," Information Executive, v. 1, no. 2, 1984.

180. Management Assessment User Driven Technologies Personal Computers, Information Centers, and Fourth Generation Methodologies, FTP Technical Library, 1983.

181. Garcia, B., "The Crwth Information Survey," _Information Executive_, v. 1, no. 2, 1984.

182. Guimaraes, Tor, "The Evolution of the Information Center," _Datamation_, 15 July 1984.

183. Glatzer, Hal, "IC Changes User/Computer Relationship," _Software News_, September 1984.

BIBLIOGRAPHY

"A 'Temp' Agency Tries for a Truce with Technology," BusinessWeek, 8 October 1984.

"A Do-It-Yourself Approach That Proved Disastrous," BusinessWeek, 8 October 1984.

"A Scramble to Supply 'The Total Solution' in Office Equipment," BusinessWeek, 8 October 1984.

Adams, David R., Powers, Michael J., and Owles, V. Arthur, Computer Information Systems Development: Design and Implementation, South-Western Publishing, 1985.

Atre, Shaku, "Information Center Software," Computerworld, 15 August 1984.

Bentley, Trevor J. and Forkner, Irvin H., Making Information Systems Work for You, Prentice-Hall, 1983.

Betts, Mitch, "Micro Info Centers Seen Catching on in Federal Offices," Computerworld, 19 July 1984.

Borbely, Jack, "Information Management: What's in Store for the Professional & The Information Center," Online, May 1984.

Clarke, William, "How Managers with Little DP Know-how learn to go On-line with the Company Database," Management Review, June 1983.

Cody, Thomas G., "How Senior Executives View Info Technology," Government Computer News, July 1984.

Cook, Rick, "Who Picks Up the Info-Center Tab?," Computer Decisions, 29 January 1985.

Desmond, John, "Bank Develops Info Center to Capitalize on Micro Investment," Computerworld, 10 September 1984.

Desmond, John, "Info Centers Seen Using Conventional Teaching Methods," Computerworld, 3 September 1984.

Dooley, Bill, "Information Centers on Rise: Need DP Management Boost," MIS Week, v. 5, 6 June 1984.

Edmonston, Jack, "Survey: How Users Are Working With Micros," Computerworld, 14 November 1984.

"EPA Opens Information Center," Government ComputerNews, May 1984.

"Fourth Generation DBMS Delivers Speed, Efficiency to Large Info Center," Data Management, November 1984.

Friedman, Selma, "The Information Center: Taking Control," Micro Manager, May 1984.

Gillin, Paul, "Consultant: Put More Budget Control in Users' Hands," Computerworld, 3 September 1984.

Guimaraes, Tor, "The Benefits and Problems of User Computing," Journal of Information Systems Management, v. 1, Fall 1984.

Hafner, Katherine, "Info Center Keeps Mum, But Users Flooding It," Computerworld, 18 July 1983.

Hannes, Richard, "Reconciling MIS, Micros: A Case for the 'Personal Info Center'," Computerworld, 19 March 1984.

Hoffman, Richard D. R., "PCs Become a Part of Avon's IS Makeup," Information System News, 5 November 1984.

Horton, Jr., Forest W., Information Resources Management: Concept and Cases, Association for Systems Management, 1979.

"Info Center Acts as Data Counselor, Boosts Productivity," Computerworld, 15 October 1984.

Jones, Kathryn, "Info Center Trend for 'Fortune 500'," Management Information Systems Week, 28 September 1983.

Kahn, Beverly R. and Garceau, Linda R., "Controlling the Microcomputer Environment," Journal Of Systems Management, May 1984.

Karten, Naomi, "Implementing the Information Center Concept: One Approach Not Necessarily Better than Another," Computerworld, 19 March 1984.

Karten, Naomi, "Performance Tuning an IC," Systems User, v. 5, April 1984.

Keefe, Patricia, "Info Center Seen Budding Under Vigilant MIS: Crwth Survey Summarizes Trends, Growth," Computerworld, 19 March 1984.

Keller, Robert, "The Climb Toward Intelligence," ICP Data Processing Management, Autumn 1984.

Kull, David, "How to Make Documentation More Usable," Computer Decisions, v. 16, August 1984.

Law, Ellen W., "Martin: Be Prepared for the Future," Government Computer News, May 1984.

Lin, C.H. Michael, "System for Charging Computer Services," Journal of Systems Management, November 1983.

Lindsay, Sue, "Information Center Bootcamp," Systems User, v. 5, April 1984.

Loew, Gary Wayne, "Finding the PC Training Course That Fits," Small Systems World, November 1984.

Mace, Scott, "Users Groups: Corporate Users Share Resources," InfoWorld, 21 January 1985.

"Managers Explain Role of Micros in Info Center," Computerworld, 7 February 1983.

Mazursky, Alan D., "Managing Micros: On Managing Change," Journal of Information Systems Management, Winter 1985.

Mazursky, Alan D., "Staffing the Microcomputer Resource Center," Journal of Information Systems Management, Fall 1984.

Mills, Chester R., "The Construction of an Information Center," Computerworld/Extra!, 30 November 1983.

Mills, Chester R., "Strategic Planning Generates Potent Power For Info Centers," Data Management, February 1984.

Minicucci, Rick, "Survey: Users, Show Us Your PCs," Today's Office, October 1984.

Miodek, Ilya, "Question: PC or Not PC," Government Computer News, 17 September 1984.

Morse, Jane and Chait, Laurence, "In Info Centers, the User Always Comes First," Data Management, February 1984.

Murray, John P., "Developing an Information Center at RAYOVAC," Data Management, January 1983.

Nolan, Richard L., Managing the Data Resource Function, 2d ed., West Publishing Company, 1982.

Oei, Mona, "Evolution of an Information Center," ICP Data Processing Management, v. 9, Autumn 1984.

"Office Automation Restructures Business," BusinessWeek, 8 October 1984.

O'Mara, Janet, "The Micro: Why Essex Is Not Afraid," ICP Interface Data Processing Management, Spring 1984.

"PC Stands Alone," The IBM System User, November 1983.

Petruzzelli, Vito G., "The Info Center--a Powerful Tool for Modern Times," Data Management, February 1984.

Pridemore, Charles, "Information Center Use Growing," Management Accounting, October 1983.

Rockart, John F. and Flannery, Lauren S., "The Management of End User Computing," Communications of the ACM, v. 26, October 1983.

Sanders, Donald H. and Birkin, Stanley J., Computers and Management, McGraw-Hill, 1980.

Schindler, Paul E., Jr., "McKesson IS Shoots to Lessen Exec Info Overkill," Information Systems News, 16 May 1983.

"Small Business Stumbles into the Computer Age," BusinessWeek, 8 October 1984.

"Software: What Lies Ahead," Computer Decisions, v. 15, November 1983.

Sonsin, W. J., "Implementing the Information Center," Information Executive, v. 1, 1983.

Stang, David J., "Microcomputer Repair: Do It Yourself," Government Computer News, 17 September 1984.

Stearns, E. W., "The Information Center: The Best Answer?," Infosystems, June 1984.

Steinauer, Dennis D., "Security for Micros," Government Computer News, 17 September 1984.

Synnott, W. R. and Gruber, W. H., Information Resource Management, Wiley, 1981.

Szczepanowski, Richard, "DOL Official: Customize Your Information Center," Government Computer News, July 1984.

Szczepanowski, Richard, "Increased Computer Use Creates Legal Questions," Government Computer news, July 1984.

"The Information Center," Infosystems, November 1984.

"The Information Center Revolution," Systems User, May 1983.

Trigoboff, Dan, "Information Centers on Rose: Capacity Planning Vital," MIS Week, v. 5, 6 June 1984.

Umbaugh, Robert E., "Defining A Corporate Information Policy," Journal of Information Systems Management, v. 1, Spring 1984.

Verity, John W., "Upstarts Outshine the Stars," Datamation, 15 November 1984.

Warner, Edward, "Tips Offered on Tying External Data Bases to Info Center," Computerworld, 28 May 1984.

Weiss, Madeline, "Planning: Doing It Right," Government Computing News, 17 September 1984.

"Who Pays for Resources of Information Center," Computerworld, 7 February 1983.

Worley, Jack, "The Information Center: A Class of Service," Infosystems, January 1985.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Technical Information Center Cameron Station Alexandria, Virginia 22314	2
2.	Library, Code 0142 Naval Postgraduate School Monterey, California 93943	2
3.	Curricular Officer, Code 37 Computer Technology Programs Naval Postgraduate School Monterey, California 93943	1
4.	LT Barry Frew, Code 54Fw Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943	2
5.	Associate Professor N. R. Lyons, Code 54Lb Department of Administrative Sciences Naval Postgraduate School Monterey, California 93943	1
6.	LCDR Matthew L. Lechleitner Math/Science Department United States Naval Academy Annapolis, Maryland 21402	4
7.	CDR T. C. Jones 13408 Virginia Willow Drive Fairfax, Virginia 22033	1
8.	LT Alex Calder VQ-3 NAS Barbers Point, Hawaii 96862	1

212106

Thesis
L3627 Lechleitner
c.1 A Systems Development
Life Cycle study of the
Information Center.